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CONTENTS OF No. 164.

	PAGE
The Chemistry of Cookery. XLIX. By W. Mattieu Williams	495
Chats on Geometrical Measurement: The Conic Sections. (*Illus.*) By R. A. Proctor	496
The Entomology of a Pond. (*Illus.*) By E. A. Butler	497
Political Life in America. By R. A. Proctor	499
A Marvellous Little Stream	499
Earth's Shape and Motions. (*Illus.*) By R. A. Proctor	500
Electroplating: Preparing the Bath, &c. By W. Slingo	502
Automatic Arctic Exploration	503
Zodiacal Maps. By R. A. Proctor	504
A Sheep Destroyer. (*Illus.*) By John R. Coryell	504
Chapters on Modern Domestic Economy	506
The Tricycle in 1884. By John Browning	507
Reviews: Custom and Myth	508
Face of the Sky. By F.R.A.S.	510
Miscellanea	511
Correspondence	511
Our Inventors' Column	513
Our Chess Column	514

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

XLIX.—THE MODERN THEORY OF FOOD.

In my last I summarised Liebig's theory of the source of vital power, and its supposed refutation by modern experiments, but had not space to state the substituted theory. I will now endeavour to do so, though not without difficulty, nor with satisfactory result, seeing that the recent theorists are vague and self-contradictory. All agree that vital power or liberated force is obtained at the expense of some kind of chemical action of a destructive or oxidising character, and is, therefore, theoretically analogous to the source of power in a steam-engine; but when they come to the practical question of the demand for working fuel or food, they abandon this analogy.

Pavy says (Treatise on Food and Dietetics, page 6):—"In the liberation of actual force, a complete analogy may be traced between the animal system and a steam-engine. Both are media for the conversion of latent into actual force. In the animal system, combustible material is supplied under the form of the various kinds of food, and oxygen is taken in for the process of respiration. From the chemical energy due to the combination of these, force is liberated in an active state; and besides manifesting itself as heat, and in other ways peculiar to the animal system, is capable of performing mechanical work." In another place (page 59 of same work), after describing Liebig's view, Dr. Pavy says, "The facts which have been already adduced (those described in my last paper) suffice to refute this doctrine. Indeed, it may be considered as abundantly proved that food does not require to become organised tissue before it can be rendered available for force-production." On page 81 he says:—"While nitrogenous matter may be regarded as forming the essential basis of structures possessing active or living properties, *the non-nitrogenous principles may be looked upon as supplying the source of power.* The one may be spoken of as holding the position of the instrument of action, while the other supplies the motive power. Nitrogenous alimentary matter may, it is true, by oxidation, contribute to the generation of the moving force, but, as has been explained, in fulfilling this office there is evidence before us to show that it is split up into two distinct portions, one containing *the nitrogen which is eliminated as useless, and a residuary non-nitrogenous portion which is retained and utilised in force-production.*"

The italics are mine, for reasons presently to be explained. The following pages of Pavy's work contain repetitions and illustrations of this attribution of the origin of force to the non-nitrogenous elements of food.

Then we have a statement of the experiments of Joule on the mechanical equivalent of heat, connected with experiments of Frankland with the apparatus that is used for determining the calorific value of coal, &c.—viz, a little tubular furnace charged with a mixture of the combustible to be tested, and chlorate of potash (better a mixture of chlorate and nitrate). This being placed in a tube, open below, and thrust under water, is fired, and gives out all its heat to the surrounding liquid, the rise of temperature of which measures the calorific value of the substance.

From this result is calculated the mechanical work obtainable from a given quantity of different food materials. That from a gramme is given as follows:—

Beef fat	27,778	Units of work, or number of pounds lifted one foot.
Starch (arrowroot)	11,983	
Lump sugar	10,254	
Grape sugar	10,038	

In Dr. Edward Smith's treatise on "Food," the foot pound equivalent of each kind of food is specifically stated in such a manner as to lead the student to conclude that this represents its actual working efficiency *as food.* Other modern writers represent it in like manner.

Here, then, comes the bearing of these theories on my subject. A practical dietary or menu is demanded, say, for navvies or for athletes in full work; another for sedentary people doing little work of any kind.

According to the new theory, the best possible food for the first class is fat, butter being superior to lean beef in the proportion of 14,421 to 2,829 (Smith), beef fat having nearly eight times the value of lean beef. Ten grains of rice gives 7,454 foot-pounds of working power, while the same quantity of lean beef only 2,829; according to which 1 lb. of rice should supply as much support to hard workers as 2½ lb. of beef-steak. None of the modern theorists dare to be consistent when dealing with such direct practical applications.

I might quote a multitude of other palpable inconsistences of the theory, which is so slippery that it cannot be firmly grasped. Thus, Dr. Pavy (page 403), immediately after describing bacon fat as "the most efficient kind of force-producing material," and stating that "the *non-nitrogenous* alimentary principles appear to possess a higher dietetic value than the *nitrogenous*," tells us that "the performance of work may be looked upon as necessitating a proportionate supply of *nitrogenous* alimentary matter," and his reason for this admission being that such nitrogenous material is required for the nutrition of the muscles themselves.

A pretty tissue of inconsistences is thus supplied! Non-nitrogenous food is the best force-producer—it corresponds to the fuel of the steam-engine; the nitrogenous is necessary only to repair the machine. Nevertheless, when force-production is specially demanded, the food required is not the force-producer, but the special builder of muscles, the which muscles are not used up and renewed in doing the work.

It must be remembered that the whole of this modern theoretical fabric is built upon the experiments which are supposed to show that there is no more elimination of nitrogenous matter during hard work than during rest.

Yet we are told that "the performance of work may be looked upon as necessitating a proportionate supply of nitrogenous alimentary matter," and that such material "is split up into two distinct portions, one containing the nitrogen, which is eliminated as useless." This thesis is proved by experiments showing (as asserted) that such elimination is not so proportioned.

In short, the modern theory presents us with the following pretty paradox :—The consumption of nitrogenous food is proportionate to work done. The elimination of nitrogen is *not* proportionate to work done. The elimination of nitrogen is proportionate to the consumption of nitrogenous food.

I have tried hard to obtain a rational physiological view of the modern theory. When its advocates compare our food to the fuel of an engine, and maintain that its combustion *directly* supplies the moving power, what do they mean?

They cannot suppose that the food is thus oxidised as food; yet such is implied. The work cannot be done in the stomach, nor in the intestinal canal, nor in the mesenteric glands or their outlet, the thoracic duct. After leaving this, the food becomes organised living material, the blood being such. The question, therefore, as between the new theory and that of Liebig must be whether work is effected by *the combustion of the blood itself* or the degradation of the working tissues, which are fed and renewed by the blood. Although this is so obviously the true physiological question, I have not found it thus stated.

Such being the case, the supposed analogy to the steam-engine breaks down altogether; in either case, the food is assimilated, is converted into the living material of the animal itself before it does any work, and therefore it must be the wear and tear of the machine itself which supplies the working power, and not that of the food as mere fuel material shovelled directly into the animal furnace.

I therefore agree with Playfair, who says that the modern theory involves a "false analogy of the animal body to a steam-engine," and that "incessant transformation of the acting parts of the animal machine forms the condition for its action, while in the case of the steam-engine it is the transformation of fuel external to the machine which causes it to move." Pavy says that "Dr. Playfair, in these utterances, must be regarded as writing behind the time." He may be behind as regards the fashion, but I think he is in advance as regards the truth.

My readers, therefore, need not be ashamed of clinging to the old-fashioned belief that their own bodies are alive throughout, and perform all the operations of working, feeling, thinking, &c., by virtue of their own inherent self-contained vitality, and that in doing this they consume their own substance, which has to be perpetually replaced by new material, the quality of which depends upon the manner of working, and the matter and manner of replacement. We may thus, according to our own daily conduct, be building up a better body and a better mind, or one that shall be worse than the fair promise of the original germ. The course of our own evolution depends upon ourselves, and primarily upon the knowledge of our own physical and moral constitution, and their relations to the external world. Of such knowledge even the humble element supplied by "The Chemistry of Cookery" is one that cannot be safely neglected.

Intimately connected with the preparation of the materials that internally sustain and renew our bodies, is that of protecting them externally. I have accordingly arranged with Mr. Proctor to follow this series (which I hope to conclude in my next) with another—necessarily shorter—on "The Philosophy of Clothing."

CHATS ON GEOMETRICAL MEASUREMENT.

By Richard A. Proctor.

(*Continued from p.* 458.)

THE CONIC SECTIONS.

A. I have been thinking over the method of treating areas which we considered in our last conversation. It seems to me that while the method is sound enough, it is in some degree artificial. Take for instance the example you gave, that of the cycloidal area;—by a certain arrangement you were able to compare the area with that of the generating circle. But, in any case, taken at random, how can you tell that this or that particular method of slicing up your area will avail to make the several parts of it comparable with the several parts of some known area?

M. Well; how can you tell that any particular method of dealing with a complicated algebraical or trigonometrical expression, will result in simplifying it? In geometry, as in other matters (even in business matters), we can but try such methods as seem likely to help us.

A. But I am told that analytical methods are sure, in these cases.

M. That is far from being the case. When you deal with an area by analytical methods, you get an algebraical or trigonometrical expression,—let us say,—for one of the minute elements into which you have sliced up your area, and you very often see at once from this expression that the area can be obtained by the process known as integration. But often enough the expression you obtain is not one you can deal with as it stands. Then you have to apply tentative processes, which may or may not lead to a solution. Of course, the more you know about the analytical treatment of various expressions, the more likely you are to succeed quickly by the analytical methods: but a similar truth holds in regard to geometrical work also. Moreover, you will find that there is no surer help to success with analytical methods, than a knowledge of the various geometrical methods, and practice in their application. These underlie, in reality, the analytical methods, and later on in your studies you will find great interest in taking your analytical work and seeking the geometrical interpretation of every process, nay of every line in it. However, let us resume our subject.

A. You promised to take the area of a parabolic segment next.

M. I did. But on consideration, we had better begin with the more familiar curve, the ellipse.

A. Can we afterwards go on to the hyperbola?

M. Hyperbolic areas are not to be dealt with geometrically quite so easily as the ellipse and parabola. In fact, it is impossible to make any exact geometrical statement about the area of a hyperbolic segment. It has been suggested—but, perhaps, mistakenly—that Shakespeare had been working on some hyperbolic area when he wrote the impatient words, "Out hyperbolical fiend! why vexest thou this man?"

A. It seems not unlikely. But had we not better turn to the ellipse?

M. Let Ab A'b' (Fig. 1) be an ellipse, axes A A', bb', and let circles be described having these axes as diameters. Now, if any radius as Cq Q is drawn to these concentric circles, then, by a well-known property, Q M and $q\,m$ (produced) meet at P, a point on the ellipse. We may conveniently take this property for use in dealing with the area of the ellipse. Complete the diagram, and mark in letters, as in the figure. Now, P M bears to Q M the same ratio that Cq bears to C Q, or Cb to C B. Hence, if we

regard P M as a strip of the semi-ellipse A b A′, and Q M as a strip of the semi-circle A B A′, we have

Strip P M : strip Q M :: Cb : C B,

and the like with all such strips into which the areas A b A′ and A B A′ may be divided by a multitude of parallels to B B′, indefinitely near each other. Hence, since each strip in A b A′ bears a constant ratio to the corresponding strip in A B A′, all the strips in A b A′ together, bear that same ratio to all the strips in A B A′ together: that is to say,

$\frac{1}{2}$ ellipse A b A′ : $\frac{1}{2}$ circle A B A′ :: bC : B C,

or ellipse A b A′ b' $= \frac{b\,C}{B\,C}$. circle A B A′ B′.

In like manner, beginning with the ratio

Pm : $q\,m$ :: Q C : qC,

we can prove that ellipse A b A′ b' $= \frac{B\,C}{b\,C}$. circle $a\,b\,a'\,b'$.

It is also evident that area P A P′ $= \frac{b\,C}{B\,C}$ area Q A Q′;

area P A′ P′ $= \frac{b\,C}{B\,C}$ area Q A′ Q′; area P b p' $= \frac{B\,C}{b\,C}$ $q\,b\,q'$;

and area P b' p' $= \frac{B\,C}{b\,C}$ area $q\,b'\,q'$.

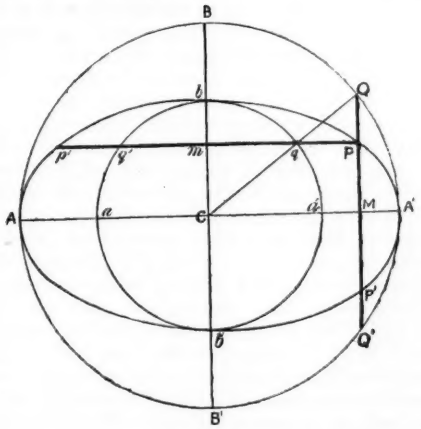


Fig. 1.

A. I see that you have here taken the *lines* P P′, Q Q′, P p', and $q\,q'$ to represent elementary *strips* of the areas you are dealing with. Can you always do this?

M. You can do it in all such cases as this, where you know that the strips in one area are of the same breadth as the corresponding strips in the other. Here they are so by the nature of the construction itself. But in other cases—in dealing with the parabola, for example—they are not so. In such cases you must consider the breadth as well as the length, and therefore you cannot use the lines as in the last case—for a line represents length, not breadth.

A. The ellipse seems easy enough to deal with. I wonder why there should be more trouble with the hyperbola, which resembles the ellipse in so many properties. How is this?

M. You say the ellipse is easy to deal with. Have you satisfied yourself on this point?

A. Why, have we not just determined its area?

M. We have shown that its area bears a certain proportion to the area of certain circles. But is the determination of the area of a circle so easy a matter? I imagine that the quadrature of the circle has been considered a problem of some difficulty.

A. Still it has been dealt with so thoroughly that we know the area of a circle of given radius as closely as we can ever want to know it.

M. Quite so. And if we had as familiar a knowledge of the curve which bears the same relation to a hyperbola that the circle bears to the ellipse, we should be able to deal as easily with the hyperbola as with the circle.

A. What curve is that?

M. What else but the rectangular hyperbola? The circle is an ellipse with equal axes, the rectangular hyperbola is a hyperbola with equal axes.

A. Then, in point of fact, all we have done with the ellipse has been to show what relation the quadrature of the ellipse bears to the quadrature of the circle.

M. Precisely. And it is just as easy, as a moment's consideration will show you, to see what relation the quadrature of a hyperbola with unequal axes bears to the quadrature of a rectangular hyperbola.

A. Will you take a moment's consideration for me, and show me this?

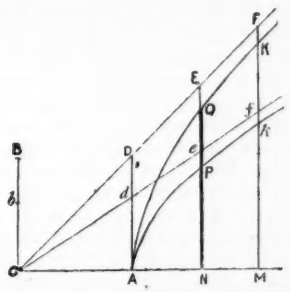


Fig. 2.

M. Suppose in Fig. 2, C A and C B are the $\frac{1}{2}$ axes of a rectangular hyperbola A Q K; C A and C b those of the non-rectangular hyperbola A P k; C D E F, C d e f, asymptotes; D A, E Q P N, F K k M perp. to C M. Then we know that

P N : Q N :: k M : K M :: C B : C b.

Hence, as in the case of the ellipse,

Area A k M : area A K M :: C B : C b;

and if we had dealt as freely with such areas as A K M, (that is the areas of the segments of rectangular hyperbolas) as we have with the areas of circular segments, this would solve as completely the problem of hyperbolic quadrature as the preceding investigation solved the problem of elliptic quadrature.

A. That is far from satisfying. Allow me to say with Shakespeare, "Out hyperbolical fiend." Let us turn to the parabola.

(To be continued.)

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

ABOVE THE SURFACE (*continued*).

In a former paper a small family of moths was referred to as having aquatic caterpillars; these will form the subject of the present paper. They are called the Hydrocampidæ, or China Marks, and are common adornments of weedy ponds. They are but a feeble band, the British species being only five in number, distributed amongst almost as many genera. The largest is but an inch in expanse of wings, and the smallest little more than half that size. The wings are rather narrow, and often most

elegantly adorned with a delicate tracery of brown or black on a satiny white or creamy ground. Like most of the Pyrales—the section to which they belong—they have long slender legs and a narrow body, extending considerably beyond the hind wings. To find these beautiful little beings, seek out a pond where tall plants, such as the Burr-reed, the Arrow-head, the Flowering Rush, and the Water Plantain rise in stately columns straight out of the water, and where the water itself is well stocked with pond-weeds; watch the luxuriant growth for a time, and you will see at any rate some of the Hydrocampidæ playing "hide-and-seek," as it were, amongst the forest of stalks and leaves. Some of their delicate forms are sure to be seen floating on the water in a more or less disintegrated condition—the corpses of such as have either been accidentally drowned, or have perished in the ordinary course of nature, and fallen into the water on their decease. Good specimens of the living insects may easily be secured by sweeping amongst their hiding-places, or by netting them as they dart out from amongst the herbage.

When at rest, the fore-wings are placed nearly horizontally, just covering the hind wings, and giving the whole insect an outline resembling that of an isosceles triangle. The attitude of rest is a matter of importance to the systematic Lepidopterist, for often special attitudes are characteristic of special families. Thus we find that some moths spread out all four wings horizontally, closely applying them to the object on which they are resting; some turn them up over their back, as butterflies do; others wrap them alongside the body so as to give themselves a cylindrical appearance; some rest with head close to the ground and tail in the air, others in just the reverse position, while, as regards the slope of the wings, there is every conceivable degree of inclination between horizontal and perpendicular, and, as a consequence, an infinite variety of triangular outline. But, to return to our China Marks. The prettiest of the family is *Hydrocampa stagnalis*, the "Beautiful China Mark" (Fig. 1). The

Fig. 1.—Hydrocampa stagnalis.

ground colour of the wings is satiny-white, and the markings consist of double, twisted lines of a rich brown colour. Beautiful to the naked eye, it is simply exquisite when viewed by reflected light with a low power of the compound microscope; the satiny scales lying row upon row on the wings, and standing erect on the head like regal plumes, glisten with dazzling brightness, tempered only by the warm brown tints of the wavy lines that form the pattern. Sloping back at the sides of the thorax, and concealing the junction of wings with body, are two plume-covered tippets, found in all Lepidoptera, but of unusually large proportions in this group. The antennæ are most elegant. To the naked eye, they are but fine threads; but under the microscope (Fig. 2) each is seen to be

Fig. 2.—Portion of antenna of Hydrocampa stagnalis, highly magnified.

composed of a series of joints carrying on their outer side a little tuft of scales similar to those on the wing, and on the inner side a number of fine short hairs standing erect like velvet pile.

But it is not in their perfect state that the principal interest attaches to the Hydrocampidæ; they are remarkable as being the only family of the Lepidoptera that are aquatic in the larval condition. Their caterpillars feed on water-plants and form cases, not like caddis-worms, of vegetable débris, but of the fresh leaves of the plants on which they feed, and within these they constantly remain beneath the surface of the water. That a caterpillar should construct a case for itself out of the leaves of its food-plant is nothing extraordinary, there being numerous instances of it amongst the Lepidoptera; indeed, one large family of minute moths, the Coleophoridæ, or "case-bearers," have been so named from their indulgence in this habit; but that a Lepidopterous caterpillar should habitually live in water is an altogether anomalous fact, as submergence is generally very fatal to these insects. Like those of the Lepidoptera generally, these caterpillars are worm-like beings, with a hard head armed with powerful jaws, and with six short legs in front, and claspers, or false legs, on the hinder segments. The eggs are laid on the leaves of pond-weeds, and in some cases, at any rate, the young grubs, when first hatched, instead of at once making cases, mine their way into the substance of the plant, and thus protect themselves while devouring its interior. The duration of this internal life seems to vary with the season; those that are hatched late in the year remain in their burrows all through the winter and do not form cases till the next spring, when the freshly-growing plants afford them suitable materials. But others have been observed to mine for only a few days, and then to emerge and begin to construct cases. The case is made of two pieces of leaf joined at the edges. In order to construct it the caterpillar, by means of its claspers, first seizes a leaf firmly near its edge, and then bites a narrow, curved channel through the leaf, beginning at the edge, and working its way round by bending its head to one side. Having then gone over the same ground again, but in the reverse direction, widening the channel, it shifts its claspers to the fixed part of the leaf, and continues the curve almost to the edge again, repeating *this* operation also a second time. The strip of leaf is now attached only by a narrow isthmus. The caterpillar next transfers itself to this almost detached portion, severs the connecting bridge, and floats away as on a raft. In this way half the case is made; then, seizing some fixed leaf in its forelegs, and guiding itself thereby, it crawls about in search of a suitable leaf from which to cut a piece for the other half. Having found one to its taste, it hauls itself and raft under the chosen leaf and makes the detached piece fast to the underside by fixing it with silk at intervals along the edge, all the time keeping itself snugly ensconced between the two. Having thus laid the foundation, as it were, it uses the lower piece as a tracing model, cuts out the upper by biting round the edges of the lower, and thus finishes the dwelling, no doubt satisfied enough with the economy of its arrangements, which have combined in the most pleasurable way the taking of a meal and the building of a domicile.

From the open end of this case it can easily feed on the plants around without unduly exposing its defenceless body. But even the best-made cases will grow old, and caterpillars, too, will grow stout, so that there is constant need for the manifestation of constructive genius. The larvæ are by no means fastidious as to the kind of leaf used for the case, and sometimes the two halves even will be of different materials. Sometimes only half the case is changed at a time, a new roof or floor being put on as occasion may require; but care is always taken that the

new piece shall be a trifle larger than the old, and in this way the case itself gradually grows and keeps pace with the requirements of its owner. Sometimes, however, especially after a moult, the caterpillar literally "turns over a new leaf," discarding the old case, and starting afresh with an entirely new outfit. Inside the rejected abode may be found the cast skin, stretched out at full length along the floor, and attached by some silken threads. The chrysalis is formed inside the case, and when about to assume this state the larva is obliged to moor its dwelling to some plant, for it would be far too dangerous to leave it floating about with its precious freight, the sport of winds and waters. Most of the above particulars apply specially to the larva of *Hydrocampa nymphealis*, a species rather larger and of a browner colour than *H. stagnalis*, but in other respects very similar to it.

(*To be continued.*)

POLITICAL LIFE IN AMERICA.

By Richard A. Proctor.

I HAVE had an opportunity of noting what Americans have described to me as absolutely essential to a right understanding of the dignity of freedom in America—the progress of a Presidential election. Let me try to record the impression which this event has produced on an Englishman who certainly views American institutions with no unfriendly feelings—nay, recognises as in progress here the most hopeful attempt at self-government in which any great nation has ever been engaged.

In the first place, the fact is forced upon one most emphatically at such a time that the best Americans keep out of politics, so that the nation is obliged to select her chief officers from an inferior class. The very name "politician" has long been akin here to a term of reproach. I have even heard men described as "mere politicians and scallawags" as if one term were about as contemptuous as the other. For this the persons responsible are those "best men in America" who avowedly avoid the political arena for more or less selfish reasons. They could, if they would, keep the inferior men out.

Secondly, one cannot but notice that while in the heat of a Presidential contest, the most virulent abuse is poured on the rival candidates, while every offence in their political or private career is displayed and exaggerated; and while words of the foulest sort are applied to them, there is a disposition (scarcely less unworthy) to forget altogether after election the known defects or evil proclivities of the men selected for high offices. I have before me as I write a paper in which the offences of one of the Presidential candidates have been abused for months in terms implying that a gaol rather than the White House at Washington would be his proper place. But the election being now over, this very paper speaks of the contest as a friendly and fraternal one. Again, consider the election of 1880. Few names are now *professedly* held in higher honour in America than that of President Garfield. His career from Log Cabin to White House is followed by young Americans with nearly as much admiration as the career of a Washington or a Franklin. Doubtless, something of this is due to the circumstances of his death, which were such as to excite the sympathy of the whole nation, and so to disarm adverse criticism. But ask any truthful American—Democrat or Republican—what was really Garfield's record before he became President, and you find it that of a man with whom no honest statesman in England would have associated. He had accepted for 5,000 dollars the duty of attorney in an important matter brought before a committee at Washington, *of which he was himself chairman*, and the decision of the committee had been set aside *for this cause* by a court of justice, no appeal being made, or indeed possible, against a decision which in England would have been utterly fatal to his reputation. It was clearly proved, again, that on another occasion he had received a bribe of 326 dollars—so clearly that his friends could find no other defence than that "he did not know better." All this and more was brought against Garfield while the election was pending, with customary exaggerations and intensifications, and abuse such as we in England can hardly imagine. This was an extreme fault on one side, but surely it was an extreme fault on the other side that his election to the Presidency (imagine its being *possible*) should cause men to forget all this, and a still more serious fault that because his death chanced to have been brought about in a most tragic and painful way, his career should be held up as an example to young Americans. Neither exaggerated abuse nor misapplied applause is worthy of a great nation of grown men.—*Newcastle Weekly Chronicle.*

A MARVELLOUS LITTLE STREAM.

AT a distance of thirty miles south of the River Diamante our route passed by a natural object of considerable interest—a stream, or rather rill, of yellowish white fluid like petroleum issuing from the mountain side at a considerable height, and trickling down the slope till lost in the porous soil of the valley below. The source from which it flowed was at the junction where a hard metamorphic rock, interspersed with small crystals of agnite, overlay a stratum of volcanic tufa. It was formed like a crater of a volcano, and full of black, bituminous matter, hot and sticky, which could be stirred up to the depth of about eighteen inches.

Floundering in it was a polecat or skunk (*Mephitis varians*), having been enticed to its fate by the desire of securing a bird caught in the natural bird lime, till a bullet from the revolver of one of the party terminated the skunk's struggle to extricate himself from the warm and adhesive bath in which it was helplessly held captive. The overflow from this fountain was, as described, like a stream of petroleum two or three feet wide, trickling over a bed of pitch or some such substance, which extended to a much greater width along the edge of the running stream at its contact with it. The material was of a very sticky nature, becoming gradually harder as it spread further out, assuming the appearance of asphalt when it became mingled with the loose sand of the adjoining soil.

While engaged in examining this natural curiosity, we came upon two small birds, caught in the sticky substance at the edge of the stream; they were still alive, but upon releasing them both the feathers and the skin came off where they had come in contact with the bituminous matter, so that we had to kill them to put an end to their sufferings. No doubt they had been taken in by the appearance of water which the stream presented and had alighted to drink, when they discovered their mistake too late. Their fate suggested the idea that in a district so devoid of water others of the feathery tribes must constantly become victim to the same delusion in a similar manner, and upon a close inspection of the margin of the stream the correctness of this inference was established by the discovery of numerous skeletons of birds imbedded in it; nor were those of small quadrupeds unrepresented, among which we recognised the remains of a fox.—*South American Traveller.*

XUM

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

CHAPTER VI.—THE EARTH'S REVOLUTION ROUND THE SUN.

ALTHOUGH the fact that the earth rotates upon her axis is one of the most striking revealed to us by astronomical researches, it is far surpassed in interest by the circumstance that the earth speeds with inconceivable velocity on a widely-extended orbit around the sun. Once we have become convinced that the earth is a globe, freely suspended in space, we are prepared to learn that this globe may rotate upon its axis. But nothing save long familiarity with the idea can render the theory of the earth's revolution round the sun otherwise than surprising. That this earth on which "we live and move, and have our being," this globe which we are accustomed to regard as the very emblem of stability and fixedness, is rushing through space with a velocity far exceeding that of the swiftest motions know to us, is an amazing fact, and one which men can only be forced to believe by the clearest and most convincing evidence. Our swiftest express trains travel with about one-thousandth part of the velocity that astronomers assign to the earth's revolution around the sun; the velocity with which sound travels is but as rest compared with that of the onward rushing earth; light itself, though its velocity is so enormous that it courses in a single second over a space that would eight times circle the earth, yet does not travel so many times faster than the earth but that her motion bears to that tremendous velocity an appreciable proportion.

To establish the fact of the earth's revolution, then, we must have irresistible evidence, for the probabilities against that theory seem irresistible.

We must for a while forget that the earth's rotation has been established, in order that the more imposing fact of her revolution may be grounded on independent evidence.

The main proof of the earth's revolution is derived from the motions of the sun, moon, and planets, upon the celestial sphere. Regarding this sphere as marked with a number of index-points—the fixed stars—for our guidance, we have to consider what the motions of the sun, moon, and planets upon that sphere actually are. Let the student remember that many of the facts now to be mentioned are such as he can abundantly verify for himself. Whatever opinion men may form about the explanation of these facts, there the facts are; and no theory can be accepted which does not give a satisfactory account of them.*

Let P E P′ E′ (Fig. 1), represent the celestial concave; P O P′ the polar axis about which it appears to rotate. Then the sun appears to circle once in a year round a circle, E E′ obliquely situated. His motion in this circle is not absolutely uniform, being faster in one part as near E, and slower in the opposite part as near E′. But year after year his motion is repeated in the most regular manner, the velocity in any part of the circle E E′ being always the same, as, year after year, he returns to that part of his course. Again, as his apparent magnitude is not appreciably altered to ordinary vision, we conclude that throughout his course he is always at about the same distance from the earth. Carefully measured with telescopic appliances, however, he is found to be slightly larger when near E than when near E′. Hence we conclude that he is slightly nearer at the former than at the latter part of his path.

Now, here at once we have an important fact to deal with. We know this at any rate for certain, that either the sun goes once in a year round the earth, or the earth goes once in a year round the sun. One or other *must* move. Observed appearances can also be accounted for, it is true, by making both bodies move round a common centre, but this is an hypothesis that has nothing in it to invite our attention.

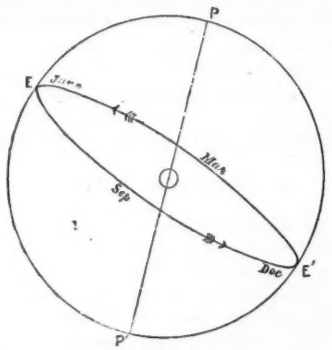


Fig. 1.

If we knew the distance separating us from the sun we could tell at once whether he or our earth were the larger body, and therefore which was most probably at rest. The estimate of the sun's distance involves considerations of too great complexity to be conveniently available here. I may mention, however, that it is rather in appearance than in reality that the proof of the sun's distance is mixed up with the theory of the earth's revolution; so that even on the Ptolemaic theory the facts dealt with in discussing transits of Venus can only be interpreted by accepting it as a demonstrated fact that the sun is upwards of 90,000,000 miles from us. Those of our readers who have given that subject the thoughtful attention it so well merits, will see that the estimate of the distance of Venus depends simply on the fact that, viewed from the ends of a measured base-line, the planet was seen in positions differing by such and such an angle. So that *her* distance comes out from the simplest trigonometrical considerations at so many millions of miles, whether the sun or the earth be in motion. Again, the proportion between the distance of Venus and that of the sun from us, though deduced by astronomers from Kepler's laws, yet follows immediately from the range of her apparent motion on either side of the sun.

We might, then, at once proceed to consider the enormous improbability that the sun, whose deduced magnitude exceeds that of our earth more than a million times, should be circling round an orb relatively so minute. For the present, however, I prefer to confine myself simply to the question of observed motions and their interpretation.

The moon, the second body we have to consider, travels also round and round the celestial sphere in a continuous manner, and with a velocity only slightly variable. But here the resemblance between her motions and the sun's ceases. He follows always the same path; the moon—travelling much more swiftly, so as to completed a circuit in a month instead of a year—travels on a path continually changing. In any single circuit her path appears to resemble the sun's, being apparently a circle inclined about five degrees to the circle E E′. But in reality it does not

* Singularly enough, the most striking of all these facts, the peculiar paths of the planets, have been left wholly undealt with by the paradoxists. Whether those people are, in truth, altogether unaware of the difficult problem presented by the apparent motions of the planets, or whether they cautiously and wisely eschew a difficulty which is too great for them, I cannot say. It is to be feared that many of the paradoxists know much more than it is convenient for them to admit; but, on the other hand, we must, in all fairness, concede to most of them an enormous—nay, a portentous ignorance on the subjects they are so eager to instruct the world about.

re-enter. The circle is continually shifting in position, though always inclined at about the same angle to the circle E E′ (Fig. 1). The mode of shifting is very complex. It may be thus generally described :—

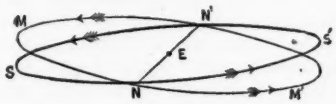


Fig. 2.

Suppose S N S′ N′ (Fig. 2) the sun's path on the celestial sphere, M N M′ N′ the moon's path at any moment—by which I mean the path she would follow if she performed a complete circuit without any shifting of her plane of motion. Now the two paths intersect in a line N E N′, and this line it is which is continually shifting. Sometimes the end N travels towards S, sometimes towards S′ ; but on the whole a motion in the former (or retrograde) direction prevails ; and in the course of about nineteen years the line N E N′ has shifted completely round in the plane S N S′ until it has the same position as at first.

Here, then, we have another set of facts to explain. Either the moon travels round the earth, or the earth travels round the moon.

In considering which view is the more probable, we may fairly take into account the estimates which have been formed respecting the moon's distance and magnitude ; because at a very early epoch astronomers obtained reliable information on this point. It has been proved that the moon is somewhat less than a quarter of a million miles from the earth, and that consequently her apparent magnitude indicates a real magnitude falling far short of the earth's. Her diameter is, in fact, little more than a quarter of the earth's, and her volume rather more than one-fourteenth.

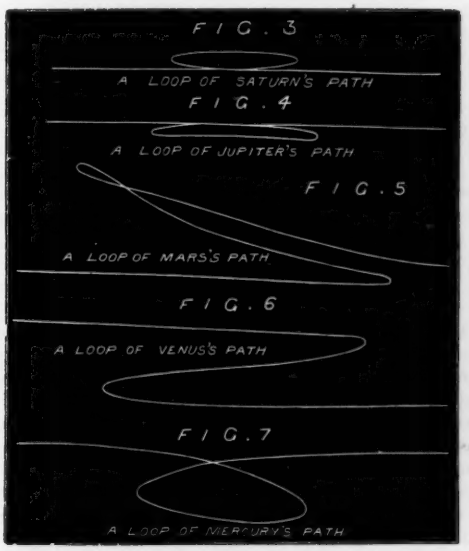
So far as the evidence goes, therefore, we are led to recognise a real motion of the moon round the earth as a more satisfactory interpretation of her apparent motion, than a real motion of the earth around the moon. And as we have as yet decided nothing about the sun's motion, we are led to infer that probably the sun also goes round the earth ; because it seems more reasonable to assume that where two out of three bodies are certainly in motion, the body at rest is the centre of *both* motions. I think it not unlikely that it was from being able to show that the earth is probably the centre of the moon's motion, that the ancients were led to believe that she is in all probability the centre of the sun's motion also. At any rate, until we get further evidence, this is the view suggested by the observed facts.

It remains to be seen how far the motions of the planets confirm this view. If we had only the sun and moon to deal with, the astronomy of Ptolemy would have no unsatisfactory basis to rest upon, setting aside, of course, the more delicate modes of modern observation, and the facts revealed by them.

The planets also go round and round the celestial sphere, each in its proper period. If they only travelled round in circles, they would confirm the impression that the earth is the centre of their motion. But from the very commencement of astronomical observation, it was observed that the planets follow very peculiar paths.

Every planet moves, speaking generally, in this wise :—It travels along as if it were about to describe such a circle as the sun or moon describes. But gradually it moves more and more slowly, until at length it stops altogether. Then it retraces its path, first with continually increasing, and then with continually diminishing velocity, until it again stops. Then it advances again ; and so on continually. The backward motion covering a smaller range than the forward motion, the planet advances on the whole—that is, travels in the same direction as the sun. And again, the backward motion not being exactly on the same track as the advancing motion, the path of the planet forms a succession of loops or convolutions. And not only has each planet its own general way of forming loops, but each loop of a planet's path has its own peculiar character.

Saturn, for instance, forms nearly 30 loops in going once round the celestial sphere, the space between the loops being about equal to the loop itself. Jupiter makes about 11 loops in going once round, the loops being larger than Saturn's, and the space between them larger yet. Mars makes a loop, and one much larger than Jupiter's, then sweeps more than once round the heavens and makes another loop, and so on continually. Venus goes more than once and a-half round the heavens between successive loops. Mercury, however, travels along a looped path more resembling that of the outer planets, making about three loops in going round his circuit. Figs. 3 to 7 show how these loops vary in shape and size.



But the successive loops made by the same planet, though exhibiting about the same range, yet vary singularly in figure. The seven figures (Fig. 8, next page), for example, exhibit a set of loops traversed by Jupiter in about half a complete revolution.

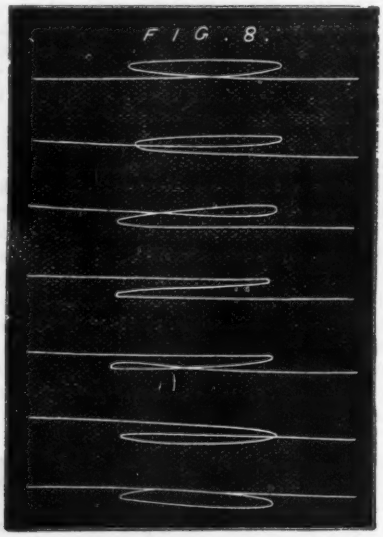
It will easily be seen how, in the other half revolution, the loops change back into the first figure.

We have in these peculiar motions a problem which *must* be solved by any theory pretending to exhibit the true character of the scheme formed by the earth, the moon, the sun, and the planets. The ancient astronomers, in forming their theories, recognised this fact in full ; and we must by no means compare the thoughtful and careful way in which they tried to master the problem, imperfect as their results were, with the egregious folly of the modern charlatan, who puts forward theories not in themselves much more imperfect, but differing altogether in this, that they are not constructed with even the vaguest reference to the observed celestial motions.

Let us inquire whether all the complicated loops and convolutions above described admit of being disentangled.

XUM

It will be granted that a theory which leaves no loop or part of a loop without an explanation at once complete and simple, well deserves all the admiration which men have so



long awarded to the labours of Copernicus, Kepler, and Newton.

(To be continued.)

ELECTRO-PLATING.

By W. Slingo.

XV.—PREPARING THE BATH, &c.

GERMAN silver articles having been subjected to the cleansing processes, require yet another operation prior to immersion in the depositing bath. This consists in dipping them into a solution of nitrate or cyanide of mercury. The former is more generally adopted, and is prepared by dissolving an ounce of mercury in nitric acid, diluted with three times its volume of distilled water. The quantity of acid required varies with its quality. As it is desirable that there should not be either too much metal or too much acid, the best plan, perhaps, is to place the mercury in a vessel, and then pour the dilute acid over it until the whole of the metal is dissolved and converted thereby into nitrate of mercury. When this is accomplished, water is added until the bulk is increased to one gallon, when a little additional nitric acid may be poured in. The immersion of the German silver articles in this solution results in a film of mercury, of a greyish or blackish colour, being deposited upon them. The characteristic brightness is produced by brushing the film softly. As mercury oxidises somewhat readily, it is essential that the article should be immediately transferred to the depositing bath. In the event of the parts of an article being soldered or leaded together, yet another process is necessary. By simply subjecting the solder, &c., to the abovementioned operation it remains obdurate, and will rarely take a deposit of silver. If, however, a stronger mercury solution is applied to the solder or other joint, the necessary metallic film is deposited; but a better way, perhaps, is that recommended by Watt. The edge or joint is immersed in a solution of sulphate of copper, and one end of a rod of iron being held in the hand, the other end is made to touch in succession the various parts of the joint. By so doing, electrolytic action is set up, the sulphate of copper is decomposed, and a bright metallic copper film is deposited upon the solder. After well rinsing, it is ready for the silvering bath. Another plan which answers well, more particularly if we have a joint other than an edge to deal with, is to attach one or two thin iron wires to the handle of a camel-hair brush, and moistening the latter with a weak solution of sulphate of copper, pass it slowly over the joint. The iron wires should be so arranged that, travelling with the brush, they come into contact with the successive parts of the soldering immediately after they have been wetted by the brush. The same action then takes place as would result from immersion in the sulphate of copper, a copper film being deposited on the solder.

To coat brass or copper with a deposit of silver, the same series of operations should be gone through as in the case of German silver.

Turning now to the electrolytic cell, the presence of the cyanide prevents the use of that form recommended for the sulphate of copper solution, and it would be the best economy to procure an earthenware bath. However, as has been previously pointed out, the adoption of the orthodox rectangular form is not in any way obligatory, and vessels of other shapes may be more cheaply purchased. They will, in all probability, require a somewhat larger quantity of solution, but that is of no great moment, seeing that it does not materially deteriorate. The relative dimensions of the bath must to some extent be determined by the shape of the object to be plated, so that it would be well for the student to make up his mind as to the kind of work he contemplates turning out before he provides himself with his bath. For some objects he would require a tall, long, and narrow bath, for others a short, wide one, while others, again, might as well be suited by a circular bath as by any other.

Having determined the kind of work to be done, and procured the bath, the next thing is to procure a couple, or, if necessary, more, bright brass or copper rods, about two inches longer than the bath and a quarter of an inch in diameter. To one end of each rod should be attached a binding-screw, for the purpose of making connection, by means of copper wire, with the terminals of the battery. If the student has the facilities, he may accomplish this object by tapping one end of each rod, and then making a screw to fit. The wire may then be clamped between the screw-head and the end of the rod.

These rods then become the terminals of the battery. From one of them—that is, from the one in connection with the copper, or positive, pole of the battery—must be suspended the silver plate or plates intended to form the anode of the electrolytic bath. Only fine silver should be used, as impurities may impair the deposit, and they will certainly injure the solution. The number and form of the silver plates must depend upon the shape of the article to be plated. They should, however, be of considerable thickness, for it must be borne in mind that for every atom of silver deposited upon the object, a corresponding atom should be dissolved from the plate connected with the battery. If this does not take place, then the atom deposited is withdrawn from the solution, and, no compensating action taking place, the solution cannot fail to be proportionately weakened. In fact, were this to continue, we should soon find hydrogen or some other metal accumulating over the surface of the object instead of silver. In the case of a flat bath, used for plating medallions or suchlike objects, flat plates of silver answer best. When the bath is long as well as narrow, it may be advantageous to use a number of such plates, but all should obviously be suspended from the same rod. It is hardly necessary

to intimate that so far as the proper circulation of the current is concerned, the number of plates is of no moment. The student must not forget, as it is known many are apt to, that the shape of the plate, or its divisions into any number of parts (all of which are metalically connected) is immaterial. What really governs the strength of the current is the amount of surface exposed; the larger the surface, the stronger the current, the more silver will there be dissolved, and the more deposited. It is, nevertheless, not always advisable to have a large surface exposed; this must be governed by the size of the object, and by its composition. There is one point to be observed in connection with the suspension of the silver plate from the brass rod. The contact must not only be sure, but the greatest precaution must be taken to guard against the solution becoming impurified by means of the wires used to suspend the silver. If copper-wire is used, its connection with the plate should be at a point well out of reach of the liquid. Lead and other metals are used for this purpose, but perhaps the best method is to have one or more *lugs* or extensions from the silver plate which shall be long enough to bend over the brass rod, and so allow the silver plate to hang down and make the necesary contact in virtue of its own weight. When the silver plates are cast, this method may be easily adopted; but if sheet-silver is used, the adoption is still possible. In this case the plate should, instead of being cut square or rectangular, have one or two lugs or extensions left on of the necessary length. When the metal is too thick to bend, it may be attached to the rod by means of a stout clamp, or binding-screw. If it is wished to plate two sides of an object simultaneously, it may be done, if the current is strong enough, by using three parallel rods instead of two, and suspending silver plates from the two outer ones. These two rods should be placed in connection one with the other. If a round object is to be plated, it may be more advantageous to use a cylindrical silver plate. However, in such cases the student must be guided and controlled by the exigences of circumstances. The objects themselves must be suspended from the rod in connection with the zinc or negative pole of the battery. They may be suspended by copper wires, which should, however, be only just thick or stout enough to support the objects in the solution. If thick wires are used, there is great probability that an unpleasantly-striking dark line will be left round the part of the object covered by the wire. The object to be coated should manifestly be entirely immersed, otherwise only a portion of it will receive the deposit. That part of the wire which envelopes the object and is immersed in the solution receives also a deposit of silver, but this is rather advantageous than otherwise.

Great care should be taken to prevent pieces of foreign metal falling into the solution. Should, for example, a piece of copper wire fall in, it would enter into chemical action with the liquid, precipitate a quantity of silver, and be itself dissolved. This would probably cause a deal of trouble. Nor should the objects be immersed before the other portion of the circuit is completed, otherwise considerable trouble may ensue. If a copper object were immersed and left hanging without a current being sent through, a portion of it would be dissolved, and a corresponding quantity of silver would be deposited, which, however, would be of a non-adhering nature, and consequently it would be found that the subsequently properly deposited coating of silver would peel or strip off. Even with this precaution, however, the "stripping" will sometimes occur, due generally to a want of proper care in regulating the strength of the current. It is advisable, more especially in early experiments, to remove the object from the bath, and apply the scratch-brush to it. If it is inclined to strip, this operation will show it. This, though, is a little anticipatory. Another precaution worthy of notice is to avoid placing a fresh object in a bath in which a partly finished object is being deposited upon. Should this be done, there is a chance of local action being set up between the fresh and the partly-finished objects, as we should have two different metals immersed in a liquid and connected externally by a metallic rod (all the conditions necessary to set up a current of electricity between the metals).

On first placing the objects in the bath, the silver plate should be lowered gradually until a thin film of silver covers the whole of the object, when the plate, otherwise known as the anode, may be lowered to its full extent. The amount of surface then exposed should not, however, exceed approximately the surface of the object. If the first film of silver is deposited very rapidly, the current is demonstrated to be too strong, and, in that case, there is great danger of the deposit stripping, whence the necessity for gradually introducing the anode; that is to say, gradually increasing the strength of the current from the minimum until the requisite strength is obtained. When a considerable thickness of silver is required, as is the case with objects likely to be subjected to considerable wear and tear, the articles are taken out after a few hours' working, and their surfaces scratch-brushed, by which means a more or less crystalline deposit, is, to a great extent, if not entirely, prevented. Were the object allowed to remain in the solution continuously until a very strong deposit had accumulated, it would most likely be of a crystalline character. The occasional scratch-brushing and subsequent immersion may prevent this.

It is, of course, easy to ascertain how much silver is being deposited by first weighing the unsilvered article, and then weighing at each removal from the solution, until the requisite quantity of silver is recorded as having been added.

(To be continued.)

AUTOMATIC ARCTIC EXPLORATION.

THE Chicago *Current* says:—Probably the most wonderful thing in connection with the whole sad history of Arctic exploration is the recent discovery of an ice-floe in the waters of Davis' Strait—west of Greenland—which had drifted from a point in the Arctic Ocean north-east of the Lena delta—where the crew of the *Jeannette* divided into three parties and took to the open waters—to the southernmost point of Greenland, and north again to Baffin's Bay. Upon this floe were a corpse and many indubitable relics of the expedition, including an article of wearing apparel marked with the name of Seaman Noros, who, it will be remembered, in company with Seaman Nindermann went a few miles ahead of poor De Long, and lived to write the most extraordinary experience ever penned by a human hand. Had these two simple seamen been able to tell, in the Siberian tongue, that their comrades were only eleven miles back, the whole De Long party would have lived to join Melville and Danenhower.

Now, the floe discovered by the Greenlanders has, perhaps, crossed directly over the North Pole. From the *Jeannette* floe to the southern point of Greenland, in a direct line across the Pole, is 3,500 miles, but by way of the northern shore of Asia and Europe—past Cape Northeast, Nova Zembla, Spitzbergen, and Iceland, and north again into Baffin's Bay—would be a distance of at least 6,000 miles. Scientifically, the life of a moving ice-floe for so many years, and its migration from one side of the world to the other,

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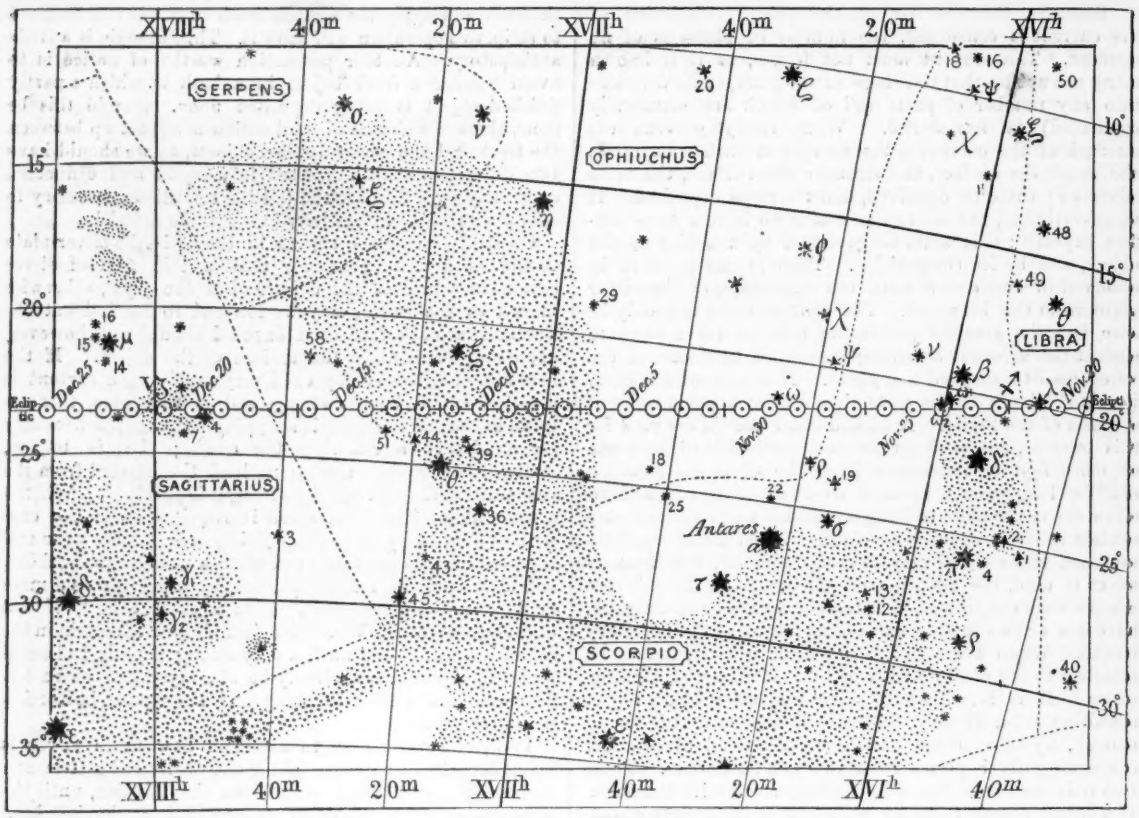


Day Sign of the Month.

ought to furnish suggestions and data more valuable than all the other fruits of Polar research combined. Self-registering meteorological apparatus, and possible gauges of the miles travelled, may in the future reveal to the investigators what the sacrifice of thousands of lives has otherwise failed to discover.

ZODIACAL MAPS.

By Richard A. Proctor.

WE give this week both the day sign and the night sign for the month, one showing the zodiacal sign now high in the heavens at midnight, the other showing the region of the zodiac athwart which the sun pursues his course at this part of the year.

A SHEEP-DESTROYER.

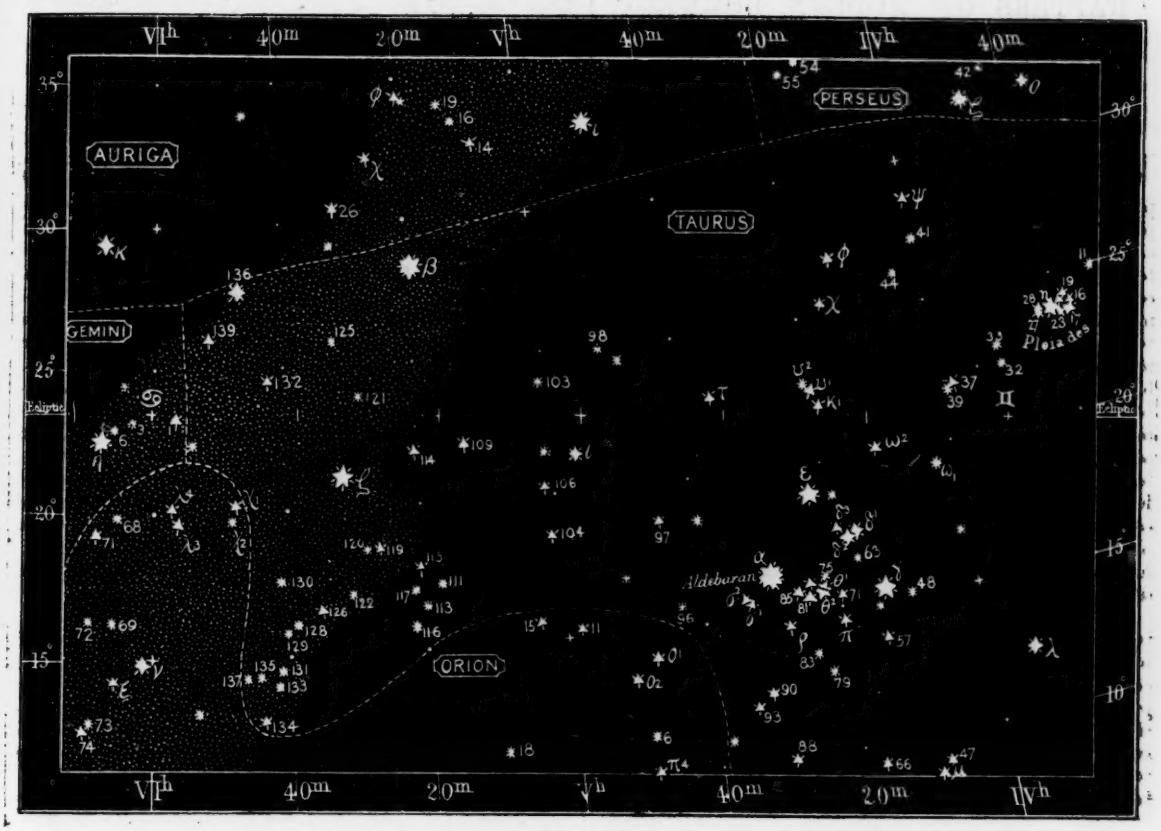
By John R. Coryell.

GROWING on our Western plains is a pretty-looking kind of grass, resembling oats, and which is called, popularly, weather grass or needle grass—botanically, *Stipa spartea*. What may be its special sphere of usefulness to man or in the economy of nature, granting that it has such a sphere, is hardly worth considering in the light of its evil works.

Looked at casually, while in its growing state, it might be mistaken for immature or bastard oats, although a moment's inspection would reveal its true character. The seed, particularly, would serve to emphasise its unlikeness

to its useful cousin, and it is this seed which, as a seemingly insignificant but really potent agent of destruction, claims our attention.

The seed in general conformation, but not otherwise, is like the oat. Its base is tipped with a tiny point as sharp



Night Sign of the Month.

and hard as that of a pin. Almost hiding this tip, and extending upward to nearly half the length of the seed, is a soft, silky, hair-like growth. The remainder of the seed, which has a total length of about three-quarters of an inch, is bare, smooth, and flinty. A minute depression, made by the unfolding of the edges of the case, runs the entire length of the seed.

From the upper end of the seed runs a long awn or beard, varying in length from four to seven inches. This awn is a simple but beautiful piece of mechanism, designed apparently for the sole purpose of enabling the seed to sow itself. It is tightly twisted, screw-like for two-thirds of its length, and then turns abruptly into a right angle, the remaining one-third being untwisted. They who are acquainted with the so-called animated oats or the wild oats will be familiar with the action of the twisted awn under the influence of wet or dry weather. The awn unloosens or tightens its twist according as it comes under the influence of wet or dry conditions, and the untwisted, right-angled end remaining quiescent enables the seed to writhe and turn and burrow deeper and deeper into the earth.

This application of its mechanical powers to the proper end of saving its life is both beautiful and pleasing; but, unfortunately, those powers, being mechanical, act with equal vigour to an improper end. Caught in the seemingly impenetrable wool of the sheep, and there subjected to the influence of alternate moisture and dryness, the awns do their work, and, incredible as it may seem, propel the seed so far as to cause the needle to penetrate the hide of the animal. The awns break off, and the needles penetrate the vital parts of the sheep, causing painful death. The harmless-looking silky growth on the needle, tending backward from the point as it does, acts as a barb to prevent any retrograde movement of the intruding needle.

The points, too, not only enter the body of the sheep in this way, but also stick in the nostrils, nose, and lips, where, however, they do less harm than when eaten and swallowed into the stomach, in which event death must follow.

The tendency to underrate the work of weak agents may lead to the thought that no material damage can be done by means of the *Stipa spartea* to sheep. How erroneous such a conclusion would be will be seen from a statement of Mr. Henry Stewart, who, in his work, "The Shepherd's Manual," says, referring to sheep in the North-Western district, that "the most frequent losses are caused by a native grass, which bears exceedingly sharp awn or beards, and called popularly 'needle grass.'"

Sheep-men guard against loss from this cause by frequent examination of the sheep during the period when *Stipa spartea* is ripe, and by burning the pasture in June, at which time the deadly grass has just commenced its growth. Prevention in this instance, as in others, is better than cure, for it is no easy matter to examine every sheep of a large herd so carefully that all the needles can be detected and withdrawn. — *Scientific American.*

XUM

CHAPTERS ON MODERN DOMESTIC ECONOMY.

VII.—THE FRAMEWORK OF THE DWELLING-HOUSE (*continued*).

GENERAL PRINCIPLES OF CONSTRUCTION.

WE have hitherto taken it for granted that the entire household arrangements are included within the principal shell or framework of the building, and such may possibly happen to obtain within the more centrally situated portions of this metropolis; they may also be found in the larger suburban tenements, and in a few country mansions. In this respect, however, the two last-named types compare unfavourably, and yet favourably, with their humbler neighbours. Unfavourably, because the most unwholesome refuse of the abode may be said to be included within the building, whereas in the smaller houses it is consigned to the garden or back yard. Favourably, because the form of apparatus used is more expensive and, *ergo*, in most cases, more efficient than that provided in the aforesaid backyard; in other words, what is gained in location by the latter is lost in practical utility through a cutting down of expenditure. It may therefore be allowed that, provided all other things are equal, the out-house system, although not quite so convenient, is undeniably the healthiest and best.

In rural districts, and even in moderately large-sized towns, out-houses are almost universally the rule; this may be said more with regard to the midland and northern counties of England than elsewhere. Unfortunately, however, it is the sewage system that is applied, in most of these cases, to the removal of excrementitious waste products from the house. There are, however, a few noteworthy exceptions to this rule, and to them we shall refer in the course of our remarks upon this all-important subject.

The principles to be observed in the erection of out-houses, may be briefly formulated thus:—1°. The water-closets ought to be situated in as convenient a situation as possible; freed from damp by a suitable floor of concrete, asphalte, or other impervious material, raised somewhat above the level of the ground, and sheltered from the wind, rain, or open-air discharge water-pipes. The water-supply ought to be conducted thereto, by pipes from a specially-isolated cistern, and the entire arrangements so disposed as to prevent the escape of deleterious products, and especially of sewer-gas. 2°. Receptacles for other waste products ought to admit of a rational sub-division; *e.g.*, house-sweepings, ashes, and garbage may be placed in one, and such things as broken glass and crockery-ware, old tins, &c, in another compartment of the dust-bin. The dust-bin itself ought to be of moderate size, and of such a shape as to permit of being readily cleared. The best kind of bin is one which can be emptied about once a week, and that by being simply turned over into the dustman's collecting-pan. A non-corrodible metal bin may be used with advantage. One caution of importance is here necessary, and that is with regard to the kind of dust-bin now most generally employed. It is usually furnished by the builder, and consists of an immovable structure after the shape of an imperfect dog's kennel, with a lid above, and a small door at one side, below. It is very often made to fit into the corner of a building, presumably to save the trifling cost of extra wooden boards for one or two of its sides. Its size is comparatively enormous, as if intended to store the offal of a large community rather than that of a single household. What, indeed, would kitchen-midden-hunting geologists of a future age say of such heaps as these! From a sanitary point of view such a dust-bin ought to be condemned, because it gives rise to what we might aptly term contaminated damp of the adjacent wall of the house, and to a mass of putrefying filth which is both disagreeable and harmful.

This leads us naturally to a question of amendment. There can be no doubt that the sewage system of London, and other similarly-constructed towns, coupled with the prevalent and very defective provisions for the removal of household rubbish, is one of the problems of the present day which calls most urgently for attention. It has been repeatedly stated that the evil has become so widespread that extensive reformation cannot be effected without an immense outlay. In its earlier days London suffered even more than it does now from an unwholesome condition of things; the house refuse was allowed to collect and fester in cesspools, and, indeed, anywhere, or rather everywhere, so that at length it became a question in which the authorities of the nation itself were obliged to interfere and to act with promptitude. Irrespective of expense, they sought to remedy the evil, and their efforts were crowned with partial success in 1871—the year of the completion of the present hydraulic system of sewerage, at a cost of from four to five million of pounds sterling. It has been shown that 12,000 lives have been annually saved through this provision. The marked mitigation of evil which followed directly upon the innovation, naturally tended to satisfy the promoters of the sewage scheme, and they little expected to find that the disinterested advance they had made for the welfare of the people was not only far from perfect, but, in reality, very defective, and but transitorily beneficial. The bulk of the sewage—about 150 million gallons—is daily discharged into the river Thames from large reservoirs, twelve miles below London. Not only does this seething mass of pollution move onwards to the sea, but, in virtue of the tides, it flows backwards towards the city itself, where the water is further contaminated from sundry minor outlets. The danger that is liable to arise from the persistence of such a state of affairs, more particularly during the warmer periods of the year, has been commented upon by almost all of our daily contemporaries. Commissions, even, have been appointed to inquire into the actual condition of things, and, if possible, to institute adequate and speedy remedies.

So far as we are able to judge, there is but one practicable way out of the difficulty; it is founded on the surest and best principle, viz., prevention. In a former number* we pointed out how the sewage question might be solved satisfactorily. The well-known proverb of the "old man and the bundle of sticks" is peculiarly applicable here. If the entrusted committee wish to attain to a happy and speedy issue without being forced to seek extraneous aid from the public funds, and a consequent increase of the rates, why do they not begin at once by taking the initiative step in the promotion of the "dry-earth" and "ash" systems? Whilst they recognise the efficacy of the last-named processes, no progress whatever in relation to those systems has been made, on the score of the overwhelming introductory expense that would be incurred by its universal application. It has been estimated that 10,000 carts, horses, and dustmen would about suffice to carry out the details of such a plan for London alone. We observed before, and, by way of emphasis, we repeat again, that it is quite possible to substitute the reform we have alluded to in the course of time. New suburban houses ought to be erected with the necessary fittings; and, as the resources of each parish stand, old ones may be cut off from the existing sewage ducts. We have reason to believe that, on this

* See this journal, Oct. 31, 1884, p. 363.

limited scale, the necessary labour for the removal of refuse would not be increased; in fact, if judiciously applied, there is in reality naught to prevent its decrease. Then, again, the utilisation of house-refuse would add to the local funds and afford provision for similar extensions city-wards. In the meantime, preventive measures, such as those now being carried out, would at first be negatively advanced through the suppression of the outflow from growing neighbourhoods, and afterwards positively aided by the natural growth of the reform, until the whole system has been completed, and London, like Manchester, would be sewageless.

In our next communication we shall give an outline of the principles upon which outhouses, in conformity with the requirements of the earth and ash systems, ought to be constructed, and show how they may add most materially to a domestic economy of the highest possible standard.

THE TRICYCLE IN 1884.

By John Browning,

Chairman of the London Tricycle Club.

VULCANIZED RUBBER TYRES.

THE possibility of tricycling on our, in many districts, imperfect roads depends on the application of vulcanized rubber as tyres for the wheels.

Dr. Richardson has stated that the most important consideration in tricycling is the reduction to the utmost of vibration. There is no method of doing this known to me so simple and efficacious as the adoption of large vulcanized rubber tyres.

Everything that tends to the reduction of the size of the tyres is likely, therefore, to prove injurious to tricyclists, and to the spread of tricycling.

A short time since I saw a statement in a cycling paper that vulcanized rubber tyres of large diameter are prejudicial to the speed of tricycles. In proof of this statement, some particulars were given of an experiment made by the elder Starley, from which it appears that he rode two tricycles of similar make, one having large tyres and the other small, down the same hill, and that the machine with small tyres ran the quicker of the two.

I would not lightly impugn the accuracy of any result arrived at by Starley; but he was, of course, not infallible. For instance, in his well-known machine, the Salvo, which was the progenitor of all front-steering, double-driving tricycles, he used a small front-steering wheel, and placed it as close as possible to the driver. It has been abundantly proved by those who have experimented in this direction, that by using a large front wheel and throwing it one foot, or even more, further forward, that vibration is much decreased, and the going of the machine improved.

Unfortunately, the makers, who are aware of this fact, cannot make their machines on the improved plan, for fear the public should decline to purchase them, as they raise what they consider the fatal objection "that a machine with a larger front-steering wheel thrown further forward does not look so nice!"

Probably a similar reason will prevent larger vulcanized rubber tires from being used, though anyone who tries them will find they possess great advantages.

Paradoxical as it may seem, they are more advantageous on light machines than on heavy ones, for the machine may be made much lighter in the frame if the wheels are provided with large rubber tyres.

The Surrey Machinists Company were the first to take advantage of this, and by making their Invincible machines on this plan they have reduced their weight from one-quarter to one-third, without impairing their durability. For instance, when they first introduced their Invincible Sociable, the lowest weight of any front steering Sociable in the market was from about 140 to 150 lb., and this with $\frac{3}{4}$-inch rubber tyres, while the weight of the Invincible Sociable with one-inch rubber tyres did not exceed 100 lb.

Mr. Smith, the manager of the company, told me nearly two years since that he had had considerable experience in riding machines with large rubber tyres, and that, the weight being equal, he considered machines with large rubber tyres the fastest. This is also Mr. Grace's conclusion, and it is mine.

Now, it is easy to make the weight of two such machines equal, because what is added to the weight of the wheels may easily be taken out of the frame.

The machine of Mr. Grace's, which I recently described as being one of the fastest machines I have ever ridden, has rubber tyres $\frac{7}{8}$ths diameter on the driving-wheels, and 1 in. on the front wheel.

My experience is that small tyres are the fastest on very good roads, but on rough roads the large tyres have a great advantage. But it is just on rough roads, where the machines run heavy, that we long to be eased of some of the work, and should, consequently, prefer the large tyres. I think it will be generally agreed that it is a good machine which goes well on a rough road.

But, besides this excellent quality of travelling easily under the most unfavourable conditions, large rubber tyres possess many other important advantages.

They do not come off the rims of the wheels nearly so frequently as small tyres do.

They increase the durability of the machine.

They reduce, most materially, the vibration to the rider, and they wear infinitely longer.

I speak within bounds when I say that a tyre one inch in diameter will last twenty times as long as a tyre half an inch in diameter with the same work.

A great number of the readers of Knowledge are tricyclists, and I shall feel much indebted to them if they will write stating how far their experience agrees with my own on these points.

The Electric-Lighting Act.—The suggestion made by the President of the Board of Trade to the deputation which recently waited upon him, that clauses should be submitted to the Board of Trade embodying the desired modifications of the Electric Lighting Act and Provisional Orders, is to be acted upon, and a committee consisting of representatives of the various electric lighting interests is being constituted to draw up such clauses.

Some rich mineral discoveries in the Illawarra district, New South Wales, have just been reported by Mr. Hardy, mining engineer, who has been prospecting for coal in the Calderwood Mountains, about three miles and a half from Dapto. The prospectors have found no less than five seams of first-class coal, which range from 4 ft. to 17 ft., together with an excellent shale seam. The coal and kerosene shale will, it is estimated, last upwards of 200 years. Besides the above-mentioned, Mr. Hardy has discovered a large seam of ironstone about 20 ft. in thickness.

A loud chorus of complaint is at present going up of the physical and mental injury and disquietude inflicted on dwellers near railway stations by the incessant shrieking of the engine-whistles. So far as we know, however, no one has so far pointed out the even more serious evil, that whistling by the drivers of locomotives has become so common as to have practically ceased to be regarded as any indication of *danger*. No one who has ever visited powder-mills can fail to have been struck with the fact that all conversation is carried on there in so low a tone as to approximate almost to a whisper. A shout or a loud call is but too well understood to mean imminent peril; and all whose ears it reaches at once look out for their own safety. If a cognate principle were only acted on in the daily routine of railways, the life of many of their most valuable servants might be annually saved.

XUM

Reviews.

CUSTOM AND MYTH.*

By Edward Clodd.

[first notice.]

THIS is a book, or, to define it more accurately, collection of papers, of remarkable value and interest. Mr. Lang's numerous contributions, both in vigorous prose and "aërylight" verse, to current literature are well-known, and the daintiest essay from his pen wears easily that grace of scholarship of which his Homeric translations, as well as the original poem, "Helen of Troy," are such solid, and withal delightful, credentials. His articles on the Family and on Mythology in the new edition of the "Encyclopædia Britannica," charged as they are with the true historic spirit, led us to expect that independent and masterly analysis of the generally-accepted method of comparative mythology known as the "solar," which the volume before us, and, in a lesser degree, his introduction to the new version of Grimm's stories ("Kinder und Hausmärchen") supply. But although controversial matter, therefore, enters largely, and of necessity, into the present work, it obscures neither the constructive material in it, the foundation of which is well and truly laid, nor the illustrations thrown freely and felicitously on every page. Specimens of the varied range and scope of these will be given presently, meanwhile the prominence which Mr. Lang assigns to adverse criticism of the solar theory requires that the measure of success or failure attending that criticism be first discussed. Remembering what a veil hung over our knowledge of the movements of races in times geologically recent, but historically remote, and especially concerning the ancestors of the European nations, we cannot easily over-estimate the value of the results which Bopp, Grimm, Schleicher, and later scholars (working on Schlegel's early hypothesis), obtained by the comparison of the languages grouped under the general term Indo-European or Aryan. The descent of the languages spoken by our composite English race, and other leading European peoples, also by Hindus, Persians, and some smaller peoples in Asia, from an ancestral tongue; one key to the earlier form of which is supplied in the Vedic Sanskrit, being demonstrated, philologists were enabled to pass from words to the things which they connoted, and to construct a vivid sketch of old Aryan life at a time when the congeries of tribes were scattered over the uplands of Central Asia, or the plains of Central Europe, for the exact site remains undetermined.

Although the vivid picture of their mode of life thus constructed out of the immaterial relics of speech is now generally admitted to have been over-coloured, chiefly from the tendency to read modern meanings into the ancient words, the importance of the discovery remains undiminished. It led to the extension of the method to the comparison of the leading mythologies of the Indo-European family, whereby common elements were traceable within them, and some semblance of order imported into what had been confused, disconnected, and misunderstood. An additional motive for inquiry was furnished by the incongruous, often coarse and disgusting features of these mythologies, explanation of which appeared to be supplied in the analysis of the proper names composing the *dramatis personæ* of the myth. The meaning of these names once determined, the key to the meaning of the story was clear, because, it is contended, they were the germs, the oldest surviving part of the story. Mr. Lang and other authorities contend, on the other hand, that the meanings are not determined, and that the names are much younger than the stories; but upon this more presently.

The analysis of the names, the solar mythologists say, proves that they were originally "appellations," applied to the powers of nature, chiefly and extensively to the sun, the dawn, and the other ever-varying phases incident to his daily path across the sky. In the early stages of language the same object would be called by different names, and the same name given to different objects, according to the onlooker's mood or standpoint; the most strikingly descriptive names becoming the most permanent. Although the primitive meaning in the course of time faded away, the words remained with changed meaning, no longer figurative, but literal; no longer fluent, but crystallised. The sun, the dawn, the cloud, came to be regarded as gods, "the *nomina* became *numina*, and out of the inextricable confusion of thought which followed, the belief in cannibal, bestial, adulterous, and incestuous gods was evolved." This is due, Professor Max Müller (the ablest exponent of the theory in this country) says, to a disease of language—*i.e.*, to the confusion arising from forgotten meanings, and with that explanation most of us have long remained content.

But the mythologists who regard the comparison of groups of allied languages as the only key to the intellectual condition of men in the past, shut their eyes, and, as with Professor Max Müller, wilfully, to every other kind of evidence. If the Aryans were a primitive race, there would be good reasons for trusting the Vedas as the record of men's earliest thought, for picturing them as passing each day in shuddering anxiety as they watched the varying fortunes of the sun—now strangling the cloud-serpent, now running his course like a giant, now plunging into the leaden sea; and for refusing to compare the myths of barbaric, and therefore degraded races, with such refined products of the human mind as Aryan myths. But the Aryans were very far from being primitive men; relatively to these they are but of yesterday, and their myths are the more or less polished survivals of a remote ancestral fancy spelling out the meaning of the ancient heavens, and working on the crudest, most confused knowledge of the earth. Moreover, although the method of the comparative philologist is uniform, the outcome varies much. Even where there is agreement as to the etymology there is difference as to the meaning of the word. This would not matter greatly if the general principle which makes the essential feature of a myth depend on the appellation was surrendered. But where this is retained the dissidence is fatal.

Professor Max Müller has contended that the irrational element in mythology can be accounted for only in one of two ways, either by taking it as a matter of fact, as an actual occurrence, or by referring it to the influence of language on thought, "so that many of the legends of gods and heroes may be rendered intelligible if only we can discover the original meaning of their proper names."

According to the *first* method, the myth of Daphne changed into a laurel-tree by the gods when nearly overtaken by Phœbus is a poetic version of the flight of a girl from the wooer she dislikes, and her concealment behind a laurel-tree.

This is the Euhemeristic method, so named after Euhemerus, who degraded the myths to commonplace history, contending that the gods were originally men who had distinguished themselves as warriors, culture-heroes, and the like, or who were ignoble drovers or freebooters. Mr. Spencer's theory of mythology, under which every form of

* "Custom and Myth." By Andrew Lang, M.A. (Longmans. 1884.)

it and of religion is based on ancestor-worship, is a purified Euhemerism.

According to the *second* method, Daphne the laurel-tree was an old name for the dawn, and Phœbus one of the many names for the sun, who pursued the dawn till she vanished before his rays.

Mr. Lang shows a *third* and "more excellent way." His method, recognising the light which the many-sided science of anthropology throws on the operations of the human mind at low stages of culture, is, in his own words, "to place the myth which is unintelligible when found among a civilised race beside the similar myth which is intelligible enough when it is found among savages. . . . The conclusion will usually be that the fact which puzzles us by its presence in civilisation is a relic surviving from the time when the ancestors of a civilised race were in the state of savagery. By this method it is not necessary that some sort of genealogy should be established between the Australian and the Greek narrators of a similar myth; the hypothesis will be that the myth is common to both races, not because of original community of stock, not because of contact and borrowing, but because the ancestors of the Greeks passed through the savage intellectual condition in which we find the Australians" (pp. 25, 26).

In this view, the name is not the earliest feature, but often the latest; it is accidental and local; the idea being essential, universal; witnessing to like explanations of like surroundings at corresponding levels of culture.

In reviewing the several methods, it seems surprising that there should be any divided opinion about the matter among those who recognise the myth-making stage as a necessary attitude of man's early thought. Where the theory of primitive purity and complete mental equipment at the outset is held, such a fall from grace as decay or disease of language assumes is logical, but, the ascent of man from a lower to a higher once granted, no evidence as to the ideas of savage races extant, and as to any corresponding idea traceable in civilised races should be unwelcome. Yet it is this evidence which the solar mythologists, for the most part, refuse to take into account; evidence preserving for them, like fly in amber, the coarse and ludicrous which are enwrapped within the purer element of myth. In this "Aryan heresy," as the late Mr. Crawfurd, on other grounds than the present, humorously termed it, the doctrine of continuity is denied. So much the worse for the heretics; their doctrine is doomed, and they had better recognise it, lest they find "no place of repentance though they seek it carefully with tears."

The anthropological method exhibits no such discordant results as the philological. In the series of chapters following an introductory explanation of grounds of dissent from Max Müller, Kuhn, and others of the same school, Mr. Lang selects typical illustrations showing survival of savage customs (therefore beliefs of which they are the outward and visible signs) in classic mysteries; of savage ideas about the heavens and earth corresponding to those in Greek myth; of savage beliefs in descent from animals surviving in Greek and other religions, and generally of the numerous analogues between the lower and the higher culture. Under this wise extension of the comparative method the myth of Cronus supplies excellent material, as our next paper will show.

SOME BOOKS ON OUR TABLE.

Economical Cookery for the Middle Classes. By Mrs. Addison. Third Edition. (London: Hodder & Stoughton, 1884.)—Mrs. Addison's little book is not only what it professes to be, a large collection of formulæ for cooking fish, meat, and *entrées*, and making soups and sweets at a small cost, but it possesses the not very common merit in cookery books of furnishing a considerable number of entirely new recipes. Our authoress would seem to have spent the greater part of her life abroad; hence Spanish, Portuguese, and even Cape dishes figure among them, for whose preparation she gives explicit directions. All seeking for some new thing in the shape of a flavour should lose no time in expending the extremely modest sum at which Mrs. Addison has appraised her very practical volume.

Shakespeare and Shorthand. By Matthias Levy. (London: Jas. Wade. 1884.)—This is an attempt to show that the corruptions of the text in the earliest copies of Shakespeare's Plays had their origin in the fact that such plays were produced from shorthand notes taken down from the mouths of the actors. Incidentally, a quantity of information is conveyed with reference to the history of stenography in England from the Tudor times downwards.

Wheeling Annual. (London: Harry Etherington. 1885)—Verily the "wheelman," be he bi-, tri-, quadri-, or omni-cyclist, gets his money's-worth for his money in this "Annual." A historical *résumé* of cycling in 1884, and tables of amateur bicycling and tricycling records; similar ones of professional achievements; jokes, essays, conundrums, tales (thrilling and otherwise), acrostics, poems, and narratives of tours, are a few subjects selected absolutely at random from the bulky book lying before us. Presumably every cyclist in the kingdom will furnish himself with a copy.

Elementary Text Book of Zoology. General Part and Special Part. Protozoa to Insecta. By Dr. C. Claus. Translated and edited by Adam Sedgwick, M.A. and F. G. Heathcote, B.A. (London: W. Swan Sonnenschein & Co., 1884.)—It is not often that a work so entirely fulfils its expressed object as does that whose title heads this notice; for it would be hard to find a better introduction to practical zoology than it affords. The volume before us is the first of the two into which Dr. Claus's excellent treatise is divided. Should the second one, which has yet to appear in its English dress, only equal this instalment, the biological student will be furnished with a concise zoological cyclopædia which will leave but little to be desired indeed. The first 179 pages are devoted to an exposition of the nature of organised (and notably animal) life generally. It begins by explaining the difference between organised and unorganised substances; goes on to point out the salient distinctive features of plants and animals; and then, beginning with the individual cell, explains how by its aggregation every particle of the animal frame is built up. The correlation and connection of organs, and the structure and functions of compound ones are treated of in succession. Anatomical and physiological details are given with regard to the special organs of sense: the nature of Intelligence and Instinct discussed, and Reproduction, Development, the Alternation of Generation, Polymorphism, and Heterogamy dealt with. After this a historic *précis* of the various systems which have been devised from the time of Aristotle to that of Darwin and Lyell serves as an introduction to the modern system of classification, and the masterly and philosophical way in which the doctrine of descent is subsequently applied to it, must be read to be appreciated. Following the Introduction comes the special or descriptive part of the work; and this ranges from the Protozoa to the Insecta; from the amorphous lump of sarcode which constitutes the entire animal in some of the Rhizopoda, to the comparatively complicated anatomy of the hive-bee. Numerous typical examples in succession of the Protozoa, the Cœlenterata, the Echinodermata, the

Vermes, and the Arthropoda are described and illustrated with a mass of beautiful and artistic woodcuts, of which no less than 491 adorn the present instalment of the work. This volume is alike creditable to its author, translator, and publisher, who seem to have vied with each other in rendering it not only valuable but attractive.

A Bibliography, Guide, and Index to Climate. By Alexander Ramsay, F.G.S. (London: W. Swan Sonnenschein & Co. 1884.)—To the meteorologist who may wish to learn what has been written on the subject of climate, Mr. Ramsey's thick volume will be found to possess value, containing, as it does, a good deal of information. With reference to what has been denominated "Sunspottery," however, its author seems to have confined his search for authorities to a great extent to our contemporary *Nature*, and to have avoided or ignored any and every scientific periodical which has shown the fallacy of a hypothesis that has been vigorously advocated form merely interested and pecuniary motives. Any one confined to the list of the literature of this subject in the volume before us, might well conceive that the connection between sunspots and the weather has been irrefragably established, instead of being repudiated by the very Meteorological Department itself!

Scientific Romances. No. 1: What is the Fourth Dimension? By C. H. Hinton, B.A. (London: W. Swan Sonnenschein & Co. 1884.)—It was only on p. 449 that we reviewed the romance of "Flatland," and here, by a "coincidence" as odd as the majority of those which have recently appeared in our Correspondence columns, we have Mr. Hinton essaying a reply to the question, What is the Fourth Dimension? Prior to the perusal of his excellent little tract we should hardly have fancied it possible for the discussion of so purely an abstract geometrical question as this to have been made so really interesting as our author has contrived to make it. So far from being (as might, *à priori*, have been anticipated) dry or dull reading, Mr. Hinton's small pamphlet will arrest the reader's attention at once, and we venture to predict that any one who, being impressed with the idea that space can only possibly possess the attributes of length, breadth, and height or thickness, will take that pamphlet up, will scarcely lay it down until he has read it to the last page.

First Lessons in English Grammar. By S. E. Guerini. (London: Wyman & Sons. 1884.)—If it be possible to make grammar pleasing and attractive to children, Mr. Guerini has certainly succeeded in doing so. The elementary rules are stated in a plain and simple manner, and the examples are precisely of the kind to arrest the learner's attention. Our author shows his wisdom in asking his pupils to parse such sentences as "this pig went to market," or "he put in his thumb, and pulled out a plum, and said what a good boy am I," rather than the long-winded phrases by which small incipient grammarians are usually scared from their subject.

We have, too, on our table, from Messrs. Cassell & Co., the *Book of Health*, to Part VIII. of which we would invite especial attention, containing, as it does, the beginning of a series of papers by Dr. Crichton Browne on "Education and the Nervous System." Some recent revelations in the matter of over-pressure in Board Schools confer notable interest upon Dr. Browne's essay just now. *Cassell's Popular Gardening*, *Cassell's Household Guide*, the *Countries of the World*, the *Franco-German War*, the *Library of English Literature*, and *European Butterflies and Moths*. Also the *American Naturalist*, *Ciel et Terre*, *Bradstreet's*, the *Journal of Botany* (with a life-like photograph and biography of the late George Bentham, F.R.S.), *Society*, the *Tricyclist*, and *Night and Morning*.

THE FACE OF THE SKY.

From December 19th, 1884, to January 2nd, 1885.

By F.R.A.S.

Low down as the Sun now is, and struggling through the haze of the winter horizon, he may yet be examined whenever it is sufficiently clear for spots and faculæ. The night sky will be found delineated in Map XII. of the "Stars in their Seasons." Mercury is an evening star, but is much too low down, even when on the meridian, to be fairly visible. Venus, slowly diminishing in lustre and getting into a worse and worse position for the observer, continues to be a morning star. Mars is invisible. Jupiter rises a little before 9h. 40m. to-night, and about 8h. 43m. p.m. on the 2nd of next January. Hence he is becoming visible during all the later part of the working hours of the night. He is almost due east of ρ Leonis. To-night, 12m. after midnight, his 1st Satellite will reappear from occultation, as will Satellite II., at 12h. 29m. p.m. On the 22nd the shadow of Satellite IV. will enter on to his disc at 11h. 40m. p.m. It will not pass off until half-past four o'clock the next morning. The next phenomenon happening at a convenient hour for the amateur is the eclipse of Satellite II. at 9h. 50m. 27s. p.m. on the 26th; but Jupiter will be very near the horizon. Later on the same night Satellite I. will be eclipsed at 10h. 39m. 8s. On the 27th the shadow of Satellite I. will leave Jupiter's disc at 10h. 10m.; the satellite casting it following it at 11h. 14m. p.m. On the 28th the egress of Satellite II. will happen at 9h. 34m. p.m.; but again Jupiter will be very low down. Afterwards Satellite III. will emerge from behind the body of the planet at 11h. 26m. p.m. Satellite IV. will reappear from occultation 29 minutes after midnight on the 31st. Finally, on the night of Jan. 2, 1885, Satellite II. will be eclipsed at 12h. 26m. 34s., and Satellite I. a little later, at 12h. 32m. 10s. Saturn is now visible all night long, and affords an all-repaying spectacle, alike to the observer with the moderate telescope and to the possessor of the largest and most powerful instrument. He continues to travel in a westerly direction away from ζ Tauri. Uranus is invisible. Neptune may be fished for in the blank region to the south-east of δ and ζ Arietis. The Moon enters her first quarter at 1h. 21m. 2s. in the afternoon of the 25th, and will be full at 26·3 minutes past 5 o'clock in the early morning of Jan. 1, 1885. Five occultations of stars will occur at convenient hours during the next fortnight. On the 23rd, B.A.C. 7986, a star of the 6th magnitude, will disappear at the Moon's dark limb at 7h. 52m. p.m., at a vertical angle of 131°; reappearing at her bright limb at 8h. 58m. p.m., at an angle from her vertex of 339°. On the 29th, 63 Tauri, a 6th mag. star, will disappear at the dark limb of the Moon at 8h. 34m. p.m., at an angle of 77° from her vertex. It will reappear from behind her bright limb at 9h. 45m. p.m., at a vertical angle of 287°. A little later the 6½th mag. star B.A.C. 1351 will disappear at the dark limb at 8h. 40m., at an angle of 46° from the vertex of the Moon, reappearing at her bright limb at 9h. 36m. p.m., at a vertical angle of 317°. On the 30th, 115 Tauri, of the 6th mag., will disappear at 8h. 27m. p.m., at the Moon's dark limb, at a vertical angle of 77°. It will reappear at her bright limb at 9h. 34m. p.m. at an angle of 245° from her vertex. Lastly, on January 2, 1885, B.A.C. 2872, a 6th mag. star, will disappear at the bright limb at 7h. 10m. p.m., at an angle from her vertex of 344°; reappearing at 7h. 36m. p.m. at her dark limb at a vertical angle of 283°. The Moon, which is in Sagittarius when our notes begin, passes into Capricornus at 8 o'clock to-morrow morning. This she quits at 4h. a.m. on the 21st for Aquarius, across which she is travelling until 6h. a.m. on the 24th, when she enters Pisces. It is 8h. a.m. on the 27th, when, having traversed this great constellation, she crosses into Aries, which she quits at 10 o'clock the next night for Taurus. Travelling through Taurus, she arrives at 6h. 30m. a.m. on the 31st, on the confines of the northern strip of Orion. She traverses this in between 10 and 11 hours, and emerges in Gemini. At 6h. a.m., on January 6, she leaves Gemini for Cancer, through which constellation she is still passing when our notes terminate.

We have received a copy of Messrs. King, Mendham, & Co.'s new and reduced price-list of electric apparatus, which is the largest, and probably the best, list ever published, treating exclusively of electric apparatus. In it will be found descriptions of batteries used, all kinds of experimental apparatus, including an improved pattern of the Wimshurst Influence Machine, and the firm's new and useful Standard Ohm Coil. Parts of apparatus for amateurs' use, and a revised wire table, giving the resistance and weight of copper and German silver wires, form special features of the Catalogue, as well as a section at the end giving information as to electrical terms, proper arrangement of batteries, and formulæ for winding bobbins, &c.

Miscellanea.

The Société International des Electriciens has decided that an exhibition shall be held in January, 1885, on the occasion of its first general assembly, not only to bring into prominent notice new appliances up to date, but also to sum up the progress made by means of lectures given by eminent electricians.

Mr. Carpenter is reported to have stated, in a lecture delivered at the Victoria Coffee Hall, in the beginning of this month, that "Sun-spot maxima . . . . are accompanied by a maximum rainfall all over the world." He can hardly have read the report of the Astronomer Royal to the Board of Visitors of the Royal Observatory on June 12, 1884, before making so very questionable—not to say baseless—an assertion.

The organisation of the whole of the Paris pneumatic postal service is now completed. This great work, costing more than a million francs, and involving over 60,000 mètres length of pipes, was inaugurated by M. de Cochery. The charge for carrying a letter to any place within the fortifications has been fixed at 3d. The two extreme points in the service are about 11,000 mètres apart, and the time required for the delivery of a letter to the remotest place in the most unfavourable circumstances, and including its conveyance from the nearest station, will be within one hour.

Overhead Wires.—Sir Charles Dilke attended last week's meeting of the Chelsea Vestry, of which he is a member, and authorised a statement to be made with reference to overhead wires. The vestry of St. George's (Hanover-square) had addressed to the Local Government Board a memorial urging that Board to bring the erection and maintenance of overhead wires under due control by some adequate local authority, and expressed the hope that Chelsea would concur with them in the matter and adopt a similar course. Sir Charles gave the Hon. Conrad Dillon permission to mention that the Local Government Board were pledged to move for a committee on the subject of overhead wires, and it was hoped that on the report of that committee a bill would be brought in by the Government early next session.

Criminal Plumbing.—The trial of Thomas C. Holland, plumber, of this city (New York), for criminally negligent work, was held before Special Sessions, November 6, and resulted in the imposition of a fine of 250 dols. In default of payment Holland was sent to prison. Dummy vent-pipes from washbasin traps had been run into partitions and there terminated. The ends of these vents had been roughly battered together, but were, of course, not tight, and allowed foul air to escape into the partitions. The whole arrangement was designed simply to deceive the Board of Health inspectors; and, to assist in carrying out the deception, a dummy terminal-pipe, supposed to be the end of a ventilating pipe, was fastened to the roof. The dummy had no connection with any *bond-fide* pipes inside the house.—*Scientific American.*

International Inventions Exhibition.—It is stated that the applications for space have now all been examined by sub-committees of the Council, and a selection has been made of the most promising. The number of applications has been so great that it has been decided to limit very strictly the admissions in those classes which may be considered to have been fully represented in the Exhibitions of the present and past year. The Council will, therefore, be obliged to refuse many valuable exhibits in such classes as those relating to food, clothing, and building construction. It will even be a difficult matter to accommodate those which have been selected, and it is feared that the list will have to be still further reduced. As soon as possible information will be sent to those who have applied for space; but the enormous number of applications, far in excess of what was expected, have made it impossible to do this up to the present. The guarantee fund now amounts to £48,280, a sum considerably in excess of that subscribed for the Health Exhibition, or for the Fisheries, the amount for the former being £26,518, and that for the latter £26,656.

Mr. A. Tylor read a paper before the Linnæan Society on Dec. 4, "On the Growth of Trees and Protoplasmic Continuity," his chief object being to show the principles that underlie the individuality of plants, and to prove that plants have a dim sort of intelligence, and are not merely an aggregation of tissues responsive to the direct influence of light. Not only this, but that the tree as a whole knows more than its branches, just as the species knows more than the individual, and the community than the unit. The result of Mr. Tylor's experiments, which have extended over many years, has been to show that many plants and trees can adapt themselves to unfamiliar circumstances, such as avoiding obstacles artificially placed in their way, by bending aside before touching, or by altering the leaf arrangement so that, at least, as much voluntary power must be accorded to such plants as to certain lowly-organised animals. Finally, Mr. Tylor contends that a connecting system, by means of which combined movements take place, is to be found in the threads of protoplasm which unite the various cells, and that this connecting system is found even in the new wood of trees. He has observed that most new wood points upwards, but year after year it changes its position, showing great mobility even in old wood.

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the* Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C. If this is not attended to delays arise for which the Editor is not responsible.

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The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

IS TEA INJURIOUS?

[1537]—Instead of three weeks only, as suggested by Professor Williams (for which I beg to tender him thanks), I have abstained three months. Without filling up your valuable space with details, suffice it to say that I find myself so much better without this beverage, that I have resolved never again to return to my "first love;" this in spite of my former strong attachment.

Mr. Liddle's [1524] facts are hardly convincing, for who has not heard of old folks who have been habitual "tipplers" all their lives? Cocoa, when only taken occasionally, has a tendency to cause biliousness, but soon loses this effect when used frequently.

A. Gaubert.

WINE, TEA, &c.

[1538] — Doubtless your correspondent's grandmother ("J. Liddle," p. 471) and millions of other people's grandmothers, as well as ten times the number of healthy men and women all over the world, have, during the greater part of their lives, consumed tea and coffee and wine and beer with impunity—and with advantage. But nowadays, because there is, here and there, a wretched being who has no command over his own appetite, who never knows when he has had enough, all these millions are to discontinue—forsooth! the use of everything that is pleasant to the taste, as if the human body was a mere machine, to be kept going with the smallest possible quantity of the cheapest fuel that can be found. It is not as if excess and drunkenness were on the increase—the reverse is the fact; our forefathers undoubtedly drank to excess; but such a thing as a gentleman the worse for liquor is a sight almost unknown at the present time, and those who assert that drunkenness is on the increase among the lower orders forget that this impression is probably produced by the facilities afforded by the telegraph and cheap newspapers of knowing things which, forty years since, were unheard of beyond their immediate localities. I have often been struck with this fact in noticing the large number of deaths from lightning that we read of in late years. It is not that lightning has now a habit of striking people more frequently than formerly, but, in old times, the news of such occurrences never reached us.

In Australia especially, the common drink of the settlers is tea, of which they consume immense quantities, and in the most objectionable form (*i.e.*, without milk), yet we never hear of any ill-effects of tea-drinking among the colonists.

Now if the faddists—who, for some inscrutable reason, prefer water which has generally come through miles of pipes, and is loaded with all sorts of impurities—would blow off their superfluous steam in endeavouring to get the adulteration laws properly carried out, they would do some good to their kind. Our forefathers, who survived their hard drinking, did so because they had pure liquor. There is the great secret. There is one comforting reflection, that these people, who wish to regulate our diet on the principle of the fox who had lost his tail, disagree among themselves to that extent that sane people may safely take the average

of their ideas as their guide, and they will find that the best thing to do is to eat and drink what they like, without taking too much of anything. Cornaro, who is the model of moderate people, consumed as much as he felt he wanted of soup, bread, eggs, &c., and fourteen ounces of wine daily. We can't do better than follow his example, especially with regard to the &c. A friend of mine not long since entertained for a day or two a couple of gentlemen of the total abstinence persuasion. They were lecturing in an adjacent town. At dinner my friend, who was not a teetotaller, consumed one glass of claret with water; the total abstainers put within them during that meal—one, six large cups of strong coffee, the other, seven of tea ! ! ! Let me ask Mr. Mattieu Williams which of these would (*cæteris paribus*) be considered the healthiest lives if they applied at a life assurance office, my friend of the glass of claret or the abstainers with the tea and coffee? Mr. M. Williams deserves our thanks for instructing us in the art of detecting adulterations, but in the matter of cutting off one by one every article of food or drink that is pleasant to the palate, I do—and I am sure also will many of your readers—implore him to "draw it mild." B. M., F.R.C.S.

VEGETABLES *v.* MEAT.

[1539]—In the September number of Knowledge, Mr. W. Mattieu Williams alludes to a retired colonel, aged eighty-two, who dwelt fifty-two years consecutively in India, and was a vegetarian. Now, I want to know where—oh, where did the aforesaid gentleman live, that he was able to procure vegetables all the year round? Not in Nagpur, surely! unless he was content to subsist on Irish peasant diet, and partake of potatoes and milk.

And such potatoes! Why one would be ashamed to offer them to pigs in Ireland.

During the six hottest months of this year our pretty wooded station here, so far as thermometer readings went, kept ahead of the rest of India, except on a few occasions when Jacobabad in Sind shot in front of us with a rash spurt, and wildly registered (if I remember rightly) from 113° to 117° in the shade. Now while this hot weather lasted, the members of our household ate meat three times a day, had ravenous appetites and enjoyed glorious health. We had no vegetables, barring the afore-mentioned apology for the potato, and, honestly, we were none the worse for the want, though occasionally, I must admit, we had hungry longings for something green, and moist, and cooling, such as a fresh salad from Covent Garden Market, or a dish of marrow-fat peas—nay, even a cabbage from a coster's barrow in the New Cut would not have been despised; but it was Hobson's choice with us, and we had to go without.

Granting, as we all must, the wholesome and refreshing qualities of vegetables as *part* of our daily dietary, might I suggest to Mr. Williams the possibility of there being persons, even in a tropical clime, who are all the better for partaking of a fair share of meat at their meals?

Short as has been my stay in this country—a little over nine months—I could not help noticing how much the Hindoos—a pulse, grain, and vegetable-eating race—seem wanting in backbone in comparison with the flesh-eating Mohammedans.

When Mr. Williams spoke so slightingly of "condiments," surely he must have had his memory or his palate full of the delicious nutty flavour of a roast shoulder of Southdown mutton, or of the succulent juices of a prime piece of Scotch beef—luxuries, alas! quite unknown to us benighted Nagpurites. What would he say to mutton tasting like the flesh of a sick goat, and beef with no more sap in it than mahogany chips!

I, for one, though no craver after spices or condiments, am grateful to our clever Indian cooks, who by their aid (in moderation, be it said) can make palatable and inviting dishes out of food that would be otherwise all but uneatable.

L. O'Shea Dillon.

Nagpur, Central Provinces, India, Nov. 19, 1884.

NOAH'S RAINBOW.

[1540]—The negroes whom I remembered as ignorant of this meteor were in or near Spanish-town, the tenth year from emancipation, and all were ex-slaves, and some (perhaps all) of African birth. Soon after writing, I found that Sir Hans Sloane, in his account of Jamaica, considered it a country rather more favourable than others to rainbow production. Of course, they are common in that latitude at sea (not, indeed, at hours like 2.15, wherein most rain-squalls break, but with any exceptionally early or late daylight ones), and Port Royal may practically be called a sea islet, being never approached along the eight or ten miles of narrow sandspit that alone connects it with land.

The whole matter was shown, in your number of June 27, to have no bearing on Noah's story whatever; as we see there are readers to whom (as to H. Rowntree) Genesis never suggested the idea of the rainbow having been new to either the world or Noah. Our teachers in childhood made us think it so; but might, with just as much, or as little, ground, have said thorns have only grown since Cain's sentence, or donkeys have only had a cross on their back (as some Catholics have been taught) since the crucifixion, or that the ram Abraham found in the thicket was the first he ever saw. My negroes, who knew not what a "bow in the cloud" meant, supposed some sort of lightning; and, of course, a "token of the covenant" might have been made of that, or of anything accompanying storms, however familiar before.

The point I argued was the entire naturalness and correspondence of Noah's story with extant facts; and should have proceeded to another, if allowed—the manifold incompatibility of the Lyellian pseudo-geology with them, both when hatched forty years ago and ever increasingly since. E. L. Garbett.

[What Mr. Garbett patronisingly calls "the Lyellian pseudo-geology" will have to be attacked by much stronger and more philosophical arguments than ever Mr. G. has himself employed, if it is to be shaken in the least.—Ed.]

RETINAL IMAGES—THE DUALITY OF THE BRAIN.

[1541]—Will you, or some of your correspondents, kindly furnish me with an explanation of the following peculiar sensations, which I have often experienced?

When I first awake in a morning it often happens that on opening my eyes I see very vividly a network of black lines, something like the branches of a river, or thus:—

By shutting my eyes again, and re-opening them, I am enabled to see the figure six or seven times. Undoubtedly it has something to do with the fibres of the optic nerve, but why I am able to see it at certain times I cannot imagine.

I should mention that I sleep facing the windows, and with the blinds usually drawn up.

Anent your articles on "Our Two Brains," I may mention a curious example of what I consider to be the separate workings of the two brains. Sitting in an easy chair before the fire on Thursday last, I fell asleep, and, as is my custom when asleep, I dreamed. The scene of the dream lay near a wood, and I perfectly remember a footbridge over a stream which I was about to cross. Awakening, I gradually approached consciousness—and, indeed, was so far conscious as to say to myself, "It is a dream," and still I saw the footbridge before me, and at the very same time, and apparently for a few seconds, I knew that I was sitting in my chair, and had the fire before me. The two scenes were present together, my eyes were still shut, the bridge was there, and yet I knew the fire was there also. I struggled to awake, which I soon did, but could not forget the curious sensation. It seemed as though the two brains for the time being refused to coalesce.

The "sentiment of pre-existence" I have often experienced from my earliest days, and used in vain to strive to recollect where the event had really happened to me before; and I endorse what you say, that the scenes are often those which could not have appeared to us at any previous time. W. W. S.

[What our correspondent sees is *not* the fibres of the optic nerve, but the shadows of the blood-vessels of the retina ("Purkinje's figures," as they are called), *vide* p. 199 of the current volume of Knowledge.—Ed.]

LETTERS RECEIVED AND SHORT ANSWERS.

James Cram. Very many thanks; but, as far as an overwhelming majority of our readers are concerned, the interest of the subject is exhausted.—Naturalist. An instant's reflection will show you that if we compare the aspect of any celestial body viewed at the Cape, it must appear inverted as seen from a British station. At Greenwich, the "Metropolitan crater" of the moon, Tycho, appears at the bottom of the moon; at Cape Town, it is seen at the *top*. Hence your difficulty.—J. Farrar. A girdle: the belly-band of a saddle.—R. McMillan. The "professor's" astro-meteorological system is utter, hopeless rubbish, and any time spent in reading his exposition of it merely wasted. The gentleman to whom you refer does own a place in Missouri.—R. A. Peacock. "Saturated Electric Steam" a little beyond us.—Anonymous (H. J. Browne?). These columns are not a refuge for destitute essays; nor can Knowledge print papers which have been refused by learned societies, either here or at the Antipodes.—T. J. Barnardo. "Night and Day" are only dealt with in their astronomical relations in these

columns.—F. G. As far as I can comprehend your requirements, Goodeve's "Principles of Mechanics," and his "Elements of Mechanism," and Sir J. Anderson's "Strength of Materials and Structures"—all published in Longmans' "Text-books of Science," —ought to suit you. In fiction, read all Dickens's works, and those of Charlotte Brontë, and "George Eliot."—M.D. I have not read the work from which you quote, but, quite obviously, we can simultaneously experience many sensations. A reply to the second part of your query will best take the form of an illustration. I am conscious of the optical sensation of a flickering light, of the tactile one of warmth, of the aural one of a slight roaring sound, and the sum of these states of consciousness make up my concept of a fire burning in the grate by my side.—P. Macleod Yearsley. I myself literally no more believe in the existence of ghosts than I do in that of the phœnix, or the hippogriff. Whether any of our readers may have reason (good, bad, or indifferent) for being more credulous I do not know. Several (second or third-hand) ghostly experiences have already been recorded in these columns.—W. A. Cooper. A map of the Moon appears on p. 223 of Vol. III. of Knowledge.—F. W. Bellamy. England is not a bran-new country in process of colonisation; and I am firmly convinced that the plan you advocate would be attended with the worst results. *If* all men were secured absolutely against want, and *if* every one possessed a cultivated intellect of the highest order, a Republic might quite conceivably exist without the glaring and deplorable abuses which at present appear inseparable (in practice) from that form of Government. It will be time enough "to solve your problem" when "the highest state of civilisation" has been attained.—J. Murray. You must not be angry with me if I fail to grasp the idea that bodies "would move from the up to the down by the only motion Nature has, and that is Time." Nor, if I fail to form a definite conception of your notion, "If our earth is passing through the deluge of solar time, how easy it is to understand if it were passed through the rest of the way in a sudden sort of way." I am in the same predicament, too, in connection with your hypothesis concerning "the Earth's motion towards the Sun, which it reduces every lap of its orbit itself and every other thing by the gain of one-quarter day every year, which is the cause of such a winter now, and such winters about ten thousand years ago, when temperature was about ten times as strong." You see, when I come across such passages as these, I am myself apt to "pass through the rest of" a letter "in a sudden sort of way."—Istoria. The earth rotates on her axis, in twenty-four hours, from west to east. Suppose that the mean sun is on the meridian of Greenwich; then it will have been due south at every place 15°, or one hour, east of the prime meridian one hour previously; in other words, it will be 1 p.m. at all such places. Similarly, one hour west of Greenwich it will be 11 a.m. Mark the result. It is noon on Dec. 19 at Greenwich. Now let us travel eastward. It is 1 p.m. (or thereabouts) at Stettin, 2 p.m. at St. Petersburg, 3 p.m. at Aden, 4 p.m. in the Aral Sea, 5 p.m. at Baikul, and so on, to 12 p.m., or midnight, of Dec. 19, in the Friendly Islands, through which the 180th meridian passes. Let us now, though, travel round the earth in a westerly direction. One hour west of Greenwich it is 11 a.m.; two hours, 10 a.m., at Cape Breton, 8 a.m.; at Philadelphia, 7 a.m.; at New Orleans, 6 a.m. (all be it noted in the early morning of the 19th), so that by the time we reach our 180th meridian in this direction it is midnight on *Dec.* 18. Hence the navigator's change of date. In answer to your second query, No. Only torpid.—Curious. Purely a medical question, to be decided by personal examination.—H. S. Dove. A 6-inch reflecting telescope would be very much more effective than a 3-inch refractor; but the reflector would cost about £30, and the achromatic £15.—Edward Brown. I regret my inability to present you with the works you ask for. Mechanics' Institutions, Workmen's Clubs, and now, in your case, a Bible-class, from time to time appeal for gifts of books by the conductor of this journal. Such have hitherto invariably been refused, and I regret that no exception can be made in your case.—T. Hurtley & Son. Delayed through being addressed to the Editor instead of to the Publishers.—F. S. Donaldson. I know nothing of the date of Charles Wesley's birth, beyond the fact of its having occurred in the year 1708.—Science Teacher asks for the address of Professor David Hughes, the inventor of the microphone, &c.—Dr. E. W. Prevost. Thanks, but its length excludes your contribution in the present crowded state of our columns.—A. M. Trübner & Co., London.—C. B. Arding and D. Pitcairn. Was unfortunately unable to avail myself of it.—T. May. I can only feel gratified at your appreciation of it.

The *Engineer* notes that about 1 per cent. of all the gas used in New York, or about 55 millions of cubic feet annually, is used in thirty of the largest theatres. This, at 8s. per thousand, ought to offer electricity a fine field.

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

SANITARY TRAPS.

"Traps," as is well known, are often insanitary in a very serious sense indeed. Mr. William Henman, of 38, Bennett's Hill, Birmingham, has invented what seem to be decided improvements in sanitary traps. In this invention the outer arm of the trap is elongated, funnel-shaped, and made in one piece, with, or attached to, a length of vertical pipe, so that no "lodgment" is allowed for sewer-gas. There are, moreover, no "made" joints, and thence great security is obtained against the admission of sewer-gas into a building. The traps may be of any suitable size, and be made of iron, earthenware, or any suitable material.

LACTO-GLYCOSE.

Mr. G. Mellin, of the Marlborough Works, Stafford-street, Peckham, London, S.E., is the inventor and manufacturer of what is claimed to be a very remarkable milk food for infants and children. One of the features of this preparation appears to be the entire absence of all farinaceous properties which do not conduce, contrary to some popular teaching, to infants' health. Starchy foods, indeed, are not good for children, and the closer the approximation to milk itself the better. Mellin's Lacto-Glycose, may be, indeed, looked upon, when dissolved in water, as a solution of Mellin's food in cow's milk, with this difference—that the peculiar organisation of the caseine in the cow's milk has been destroyed simply by mechanical means, viz., by the prolonged stirring and trituration of the cow's milk with Mellin's food during the process of evaporation at a low temperature. The milk is obtained from the best country sources, and as large quantities are always manipulated, a certain average milk is obtained, which is, no doubt, more stable in composition than milk from one cow, so often recommended. It can easily be inferred how well adapted this form of food must be for hot climates, where milk is generally more or less in a state of decomposition, or on board ship, where good milk cannot be obtained for the feeding of infants.

AN AUTOMATIC BOLT AND AN UNPICKABLE DOOR-LOCK.

What is known as Hancock's Patent Invisible Automatic Bolt and Unpickable Door-lock is an invention having for its object improvements in fastenings for street and other doors and windows, and other similar openings. In this invention there are three long bolts, radiating from the centre to the circumference of the door. One of these bolts, which may be called the main bolt, is placed in a horizontal line with the lock of the door, and the other two bolts are placed perpendicularly—one fastening into the centre of the frame at the top, and the other into the plate beneath. The handle is fixed in the centre of the door, from which the bolts are worked by means of a cog-wheel placed upon the spindle of the handle, and acting upon a rack upon each of the several bolts. A slot cut into each bolt, and which works backwards or forwards upon a stud, holds the bolt firmly in gear against the cog-wheel. The mechanism being inside the panels of the door, is out of sight, and the handle itself, which is secured to a disc, can, if necessary (together with the spindle and cog-wheel), easily be removed.

Should it be considered desirable to retain the usual lock in addition to Hancock's invention, an important feature in this appliance consists of a slotted plate upon the main horizontal bolt, which plate, being shot over the ordinary keyhole, renders the lock unpickable. By turning a small key in the disc of the handle, all the bolts can be thrown into or out of gear with the central cog-wheel, which in turn forms also a rachet-wheel, to which a catch, held in position by a spring, is attached, thereby holding the bolts rigidly in position until released by means of a proper key.

For asylums and other public institutions, theatres, banks, strong-rooms, offices and warehouses, as well as the doors of private houses, the cabins of ships and yachts, and, indeed, for all purposes where absolute security and safety are required, this invention is obviously of the highest consequence, and will doubtless command the attention its importance deserves. It is also applicable to existing doors, and being exceedingly simple in construction is not likely, we think, to get easily out of order.

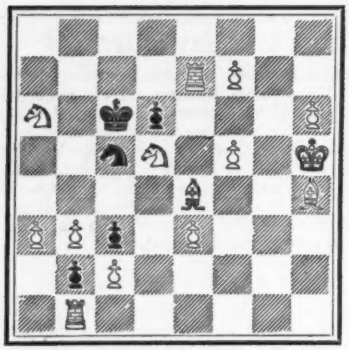
Our Chess Column.

By Mephisto.

PROBLEM No. 141.

By C. Planck.

Black.



White.

White to play and mate in three moves.

SOLUTION.

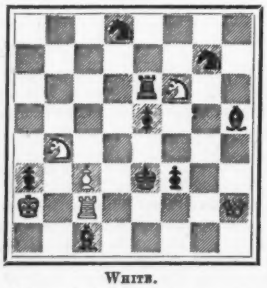
Puzzle No. 140.

Black's last move might have been P (Q2) to Q4. White plays 1. P × P en passant, discovering check, and mate next move.

Whitby, December 7, 1884.

Dear Sir,—My problem referred to by your correspondent in this week's Knowledge was originally published in the *Illustrated London News* for Dec. 30, 1854. It was, as far as I know, and as your correspondent says, the first problem in which the R makes way for the Q. In my problem the R is moved twice before the ch with the Q takes place. Four move problems were more in vogue thirty years ago than they are at the present time. The problem, unfortunately, admitted of another solution, in four moves. Mr. Staunton, who was at that time Chess Editor of the *Illustrated London News*, and who frequently took the law into his own hands with regard to young composers, preferred the "cook" to the original solution, and published it instead of mine. I remember about that time Mr. S. writing to me and also to J. B., of Bridport, stating that the proprietors of the *Illustrated London News* objected to our sending problems to what Mr. S. called the "small fry," alluding to "Cassell's Penny Illustrated Paper," "Home Circle," &c. Although our names did not appear in those journals, for some time after that we used to contribute for some time under the nom-de-plume of "Domino," J. B., and "Modestus" myself.

Black.



White.

(Corrected as a three mover).

I was always a great admirer of Mr. Healy's clever and world-famed Bristol problem, but it appears that as far as ideas in Chess problems are concerned, there is "nothing new under the sun.

N. Grimshaw.

THE EVANS GAMBIT.

We have firstly shown that, by declining the Evans, Black has a safe game. Then we have given Black's reply of 5. B to B4, although in the after-play White has an attack, Black ought to be able to defend his game, and he has a Pawn more. There would, therefore, really be no necessity of going into Black's reply of 5. B to R4, as we think it is of more importance to master the principle of the *best* lines of play in each opening, than to know every principal variation in an opening.

But having given a few specimens of the Compromised Defence, we shall give a few more variations arising from 5. B to R4. 1. P to K4, P to K4. 2. Kt to KB3, Kt to QB3. 3. B to B4, B to B4. 4. P to QKt4, B × P. 5. P to B3, B to R4. White can avoid the Compromised Defence by playing

6. Castles	P to Q3
7. P to Q4	P × P
8. P × P	B to Kt3

and we have the same position treated before, and arising from the defence of 5. B to B4. Instead of 8. P × P; White may also play

8. Q to Kt3	Q to B3

which gives White a good attack by either P × P or P to K5, but Black would have done better to play 8. Kt to R4 instead of Q to B3

9. P to K5	P × P
10. R to K sq.	

and White has a strong game, for if now 10. KKt to K2, then 11. B to KKt5, Q to Kt3. 12. B × Kt, Kt × B. 13. Kt × P and White ought to win; or

	Kt to R3
11. B to Kt5	Q to B4
12. Q to R3	

with a fine game. It is, therefore, best to avoid this attacking variation when playing on the defensive.

The following is also an interesting variation in the Opening, when in reply to 6. Castles, Black plays

6. Castles	Kt to B3
7. P to Q4	Castles
8. Kt × P	Kt × Kt (*a*)
9. P × Kt	Kt × P
10. Q to Q5	B × P
11. Kt × B	Kt × Kt
12. Q to B3	

and White will have a good game by playing B to R3.

(*a*) If, instead of 8. Kt × Kt, Black plays 8. Kt × P then follows:

8.	Kt × KP
9. B to Q5	Kt × QBP
10. Kt × BP!	R × Kt

(If Q to K2. 11. Kt × Kt followed on B × Kt by 12. B to KKt5.)

11. B × R (ch)	K × B
12. Q to Kt3 (ch) with the better game.	

Contents of No. 163.

	Page
Science and Theology. By R. A. Proctor	475
Pleasant Hours with the Microscope. (*Illus.*) By H. J. Slack	476
Our Two Brains. By Richard A. Proctor	477
The Workshop at Home. (*Illus.*) By a Working Man	479
Other Worlds than Ours. (*Illus.*) By M. de Fontenelle. With Notes by R. A. Proctor	480
Rambles with a Hammer. (*Illus.*) By W. Jerome Harrison, F.G.S.	482
First Star Lessons. With Map. By R. A. Proctor	484
Photographic Recreation. (*Illus.*) By W. Slingo	485
Chapters on Modern Domestic Economy. VI.	487
Reviews	488
Rowland Hill Benevolent Fund	489
Miscellanea	489
Correspondence: A Strange Form of Afterglow — Economy—Duodecimal Notation—The Sentient Eye the only Colour-box—No Matter, &c.	490
Our Inventors' Column	492
Our Whist Column	493
Our Chess Column	494

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